SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, DECEMBER 2, 1904.

CONTENTS:

The American Association for the Advancement of Science and Convocation Week... 737

An Analysis of the Phenomena of Organic 'Polarity': PROFESSOR T. H. MORGAN.... 742

Mosaic Development in the Annelid Egg: PROFESSOR EDMUND B. WILSON..... 748

Scientific Books:—
Jennings on the Study of the Behavior of Lower Organisms: DR. ROBERT M. YERKES. *Recent Books on Economic and Social Science*: DR. JOHN FRANKLIN CROWELL..... 750

Scientific Journals and Articles..... 759

Societies and Academies:—
Philosophical Society of Washington: CHARLES K. WEAD. *Geological Society of Washington*: DR. GEORGE OTIS SMITH. *Biological Society of Washington*: WILFRED H. OSGOOD. *Chemical Society of Washington*: L. S. MUNSON, DR. A. SEIDELL. *N. Y. Academy of Sciences, Section of Biology*: PROFESSOR M. A. BIGELOW. *Clemson College Science Club*: HAVEN METCALF. *Onondaga Academy of Science*: J. E. KIRKWOOD. *Wellesley College Science Club*: GRACE E. DAVIS..... 760

Discussion and Correspondence:—
Davenport's 'Statistical Methods': PROFESSOR KARL PEARSON. *Corals*: PROFESSOR J. STANLEY GARDINER. *Further Comments on the Guatemalan Boll Weevil Ant*: DR. WILLIAM MORTON WHEELER. *Are They Sympathetic Drums?* E. H. HAWLEY..... 765

Quotations:—
Science in the British West Indies..... 769

Economic Entomology at the World's Fair: PROFESSOR F. L. WASHBURN..... 769

The Royal Society..... 770

The Philadelphia Meeting of the American Association for the Advancement of Science and Affiliated Societies..... 771

Scientific Notes and News..... 772

University and Educational News..... 776

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND CONVOCATION WEEK.

THE permanent secretary of the American Association for the Advancement of Science has compiled an abstract of the communications printed in SCIENCE early in the year in regard to the meetings of the American Association and the special scientific societies, which is here printed, in order that further discussion may be elicited either in the columns of SCIENCE or at the approaching meeting of the association.

NICHOLS, E. L. (29 Jan., '04, No. 474, p. 192).

The plan of convocation week is a distinct step in advance. * * * The general feeling in the west seems to be for summer meetings; in the east for winter meetings. Many of us would be glad of a choice, with the privilege of attending either or both. Summer meetings should be held in some attractive and accessible resort; in mountains, on lakes or at the seashore. Select earliest possible date after closing of colleges and thus avoid the summer rush to these places. Bringing together of various affiliated societies at a common meeting place helps to mitigate one of the most unfortunate features of modern specialization in science—the separation of men of science into small groups. Question of expense of two meetings a year not worthy of consideration. It is imperative that the association afford those members who can not attend the winter meetings an opportunity for intercourse with kindred spirits at time and place possible to them.

W. LE CONTE STEVENS (29 Jan., '04, No. 474, pp. 192–4).

Gives his hearty approval to the editor's suggestions and views. Commends as well worth trying the plan (see editor's article) of each society sending accredited delegates to the annual meeting.

J. S. Kingsley (29 Jan., '04, No. 474, pp. 194–5).

It seems best that societies retain their independence and hold their meetings without regard to movements of larger organization. Might meet together where accommodations were adequate but such places would be few and far between. Separate societies have by right of preemption a claim upon Christmas holidays for their meetings.

Jas. Lewis Howe (5 Feb., '04, No. 475, pp. 228–230).

Each society should have its regular annual meeting in *summer* for presentation of papers, for excursions, for study or for whatever is of most value to the members as specialists. Meetings should be held without regard to those of any other society, as to either date or place. In winter should be held a *convocation week* meeting of all the scientific societies together with the American Association. No papers of restricted interest should be read; presidential addresses and lectures should be given and sectional discussions on topics of general *sectional* interest. No inconsiderable attention should be paid to social side of these meetings but each day should be properly apportioned. Advocates a federation to take place of existing organizations. Council to be made up of representatives chosen by the societies. Finances to be on same basis as at present. Addresses to be printed in Science and 'Proceedings' to be discontinued. Such a winter gathering should be held in a large and easily accessible center. To obviate difficulty of great distances separating workers hold general meeting biennially and divide country into several geographical sections with meetings in each on alternate years.

H. W. Wiley (5 Feb., '04, No. 475, pp. 230–231).

Advocates the solidifying of smaller societies into national societies which latter are to bear same relation to sections in the American Association for the Advancement of Science as the American Chemical Society does to Section C at present. Believes there is too great a tendency to organize separate and independent societies in each branch of investigation. Believes in American Medical Society affiliating with the American Association for the Advancement of Science. If all this could be accomplished we should more than quadruple the membership.

John M. Clarke (5 Feb., '04, No. 475, pp. 231–2).

Confesses to a 'feeling of apprehension at the insistent and impetuous efforts which are making toward the centralization of scientific endeavor in the United States and the creation of a formidable scientific machine in which individuality is to be reduced to a cog.'

"I am disposed to apprehend that centralization of science means the creation of a juggernaut which will crush endeavor, stupefy ambition, incinerate stimulus, minify personal achievement and cachinnate at honor."

O. T. Mason (5 Feb., '04, No. 475, pp. 232–233).

Take especial pains to have at annual and mass meetings men of distinction, of whom all have heard and whom they desire to see. Encourage specialization. Closest affiliation of specialists and aggregation into a mutually helpful cooperation are necessary to the intention of a science. It can not be too compact or too lively.

Simeon E. Baldwin (12 Feb., '04, No. 476, pp. 263–264).

I think the association meetings should be held when and where they will attract the largest attendance and sectional or affiliated society meetings so arranged as to make it easy for members to pass from one room to another and hear something on many subjects. Largest attendance, I believe, can be secured in *July* or *August*. Convocation week is not even a free week for all college and university professors, to school teachers seldom free, and to business and professional persons, rarely if ever free.

Theodore W. Richards (12 Feb., '04, No. 476, pp. 263–264).

A general meeting once a year ought to be

enough. Both midwinter and midsummer are likely to be unpleasant for travel in America, and therefore early autumn seems most feasible time, unless colleges could be induced to give a common spring vacation. Another argument against midwinter is that laboratory work is usually in best shape to show after winter-work is over and in the spring or autumn.

WILDER D. BANCROFT (12 Feb., '04, No. 476, pp. 264–265).

Improvement of meetings of sections necessary before men working in different fields can be brought together. Attendance at meetings largely from a sense of duty. Presiding officers too often overload the program and give no opportunity for discussion. Local members plan too many excursions for each afternoon. It is a waste of energy by committee and by visitors. Usefulness of the meeting lies in the personal element, in making men acquainted, in giving them a chance to discuss things and to exchange ideas. In morning have short papers; if possible of general interest, each paper followed by animated discussion. In afternoon men get together to talk over things more carefully, also for one excursion a day. In evening, general social gathering not confined to single sections.

CHAS. W. HARGITT (12 Feb., '04, No. 476, p. 265).

Must of necessity exist many technical societies, and there will be more rather than fewer. There then remains the 'imperative necessity for such organization of scientific effort as will make possible concentrated and consistent and direct sentiment for the enactment of needed measures of influence for whatever emergency may call for such.' Society of Naturalists did much of this class of work but it was too limited. Believes that the American Association for the Advancement of Science and in 'technical societies there are conditions and factors which properly correlated and adjusted, afford the most hopeful outlook for organized scientific progress within present generation.'

C. H. HITCHCOCK (12 Feb., '04, No. 476, p. 266).

Likes suggestion of two meetings and thinks localities might be chosen to fit the season; winter in the south, summer in the north or between east and west. With some affiliated societies, they could meet in the winter and put all their energies into work in the summer. The publication question is still open; if there were two annual meetings there could be two volumes printed, with some of the more important papers.

J. H. LONG (19 Feb., '04, No. 477, pp. 309–310).

Advocates the plan of *Section C* and the *American Chemical Society*. This will necessitate deciding upon and publishing places of meeting several years ahead. Suggests a committee from association, perhaps committee on policy, taking matter up and inviting cooperation from various societies. Thus a program for several years in advance can be prepared. *Convocation Week:* Not fair to draw conclusions from either the successful Washington or from the St. Louis meeting which was not so satisfactory. Personal preference for general meeting in June, just after commencement season. This is often too early for eastern schoolmen. September too late for college men and in August it is too hot.

MARCUS BENJAMIN (19 Feb., '04, No. 477, pp. 310–311).

What is needed is a consistent policy extending over a term of years in order that the advantages and disadvantages may be properly weighed. Council should be as nearly permanent as possible and changes limited to the new officers elected each year. The governing body should be changed only by a majority of its members.

JAMES E. RUSSELL (19 Feb., '04, No. 477, pp. 311–312).

Suggests that once in two years all meet in *same place* and on alternate years the affiliated groups serve their various interests. Much would be gained by returning biennially to the same place of meeting. It would tend to give the association a fixed home and a permanent and reliable constituency.

C. M. Woodward (19 Feb., '04, No. 477, p. 312).

Prefers special meeting at convocation week and the general association meeting ('scientific, technical and social') to be held in summer, either week before or after National Educational Association. Persons claiming membership in affiliated societies ought to pay something into association treasury or else their society pay for them.

Ernest Fox Nichols (26 Feb., '04, No. 478, p. 340).

Proposes two meetings: popular one in summer and a convocation week in winter which would thus serve as 'a clearing house' for the affiliated societies and the sections. Believes financial matters will interfere with two meetings.

E. H. S. Bailey (26 Feb., '04, No. 478, p. 341).

Convocation week meetings have proven satisfactory. * * * General meeting in late summer breaks in too much on vacations or seriously interrupts laboratory investigations or scientific excursions. Can be no valid objection to having semi-annual meetings of sections or of affiliated societies held during the summer months, but this should not interfere with attendance at the larger and more important *annual* meeting held in the winter at some central and convenient point.

T. C. Hopkins (26 Feb., '04, No. 478, pp. 341–342).

Proposes meetings of association sections in midsummer (not all sections at the same place) at such places as can be used to benefit that particular section by excursions, study or research. Sections could go to smaller places and thus enlarge scope of society and make many more adherents. Then have also the regular winter meetings.

Thomas H. MacBride (26 Feb., '04, No. 478, pp. 342–343).

Suggests for the botanists to maintain the section for botany in the association at all hazards and have but a single Botanical Society of America with at least two meetings a year, and always in connection with the American Association for the Advancement of Science. Let program of Section G consist of two parts; one of popular character held in forenoon of each day; the other to be purely professional.

Chas. S. Howe (4 Mch., '04, No. 479, p. 383).

Suggests appointment of representatives from each national society to meet at some central point this summer and thoroughly discuss the question in all of its bearings. Believes that Science might take the initiative and request societies to send representatives to such a meeting.

J. C. Branner (4 Mch., '04, No. 479, pp. 383–384).

States that 'those of us who live on the Pacific slope have some objections peculiarly our own.' Loss of time from Christmas vacation by rushing across continent and again at close of meetings recrossing. Trip is one of several thousand miles and requires from six to ten days. 3. Unable to obtain sufficient reduction in railway rates. 4. Loss of a few days that would be spent quietly at home. *Summer time* the meeting will only occupy part of the vacation period. However we fully realize that the question should be settled by the majority.

Ch. Wardell Stiles (4 Mch., '04, No. 479, pp. 384–385).

Let the present association be taken as a basis for national organization. Let present council be supplanted by a house of delegates, composed of representatives from each state society, number to be in proportion to the state membership; let all business affairs, questions of policy, etc., be transacted by this body. Let national association hold meetings convocation week and be divided into as many sections as necessary or desirable for purpose of presenting papers. *But* let it also be divided into state associations for purposes of representation.

C. Judson Herrick (4 Mch., '04, No. 479, pp. 385–386).

Believes that final adjustment will be "summer meeting of association with field excursions prominent, some of sections perhaps meeting in different places, and a convocation meeting in the winter devoted mainly to reading of technical papers, with a due proportion

of time devoted to public discussions and lectures on themes of general scientific interest and to social intercourse. Any attempt to force societies into summer months is foredoomed to failure."

CHAS. E. BESSEY (11 Mch., '04, No. 480, pp. 429–431).

Have one complaint about convocation week. It should come a week later or the state meetings a week earlier; they now interfere. Am inclined to accept Dr. Cattell's suggestion of a big winter meeting alternating with smaller and less formal summer meetings. Necessary to fix on places of meeting several years in advance and decide on general features of programs a year or so before the meetings.

GEO. F. ATKINSON (11 Mch., '04, No. 480, pp. 431–433).

Believes association is drifting from policy of keeping in close touch with general public and young students. Due to two causes or to one of the two: (1) To the change from summer to winter meetings; (2) to the tendency to discontinue former policy of extensive work and to desire to federate the different societies of the country. * * * *Time of Meeting:* Difficult unless Professor Nichols's suggestion is adopted and we hold both a summer and a winter meeting. Summer in the north and winter meeting in the south.

W. J. HOLLAND (11 Mch., '04, No. 480, pp. 433–434).

Idea of convocation week theoretically admirable but selection of time unfortunate. Christmas joys and festivals antedate the American Association for the Advancement of Science. Time of meeting should be in midsummer vacation.

W. F. GANONG (18 Mch., '04, No. 481, pp. 463–464).

Local sectional meetings should be held under auspices of *American Society of Naturalists.* A second group of societies desirable for (1) Vigorous but friendly rivalry will be distinctly advantageous and much preferable to a society monopoly. (2) American Association unlimited as to qualifications of membership and must always have and care for a large semi-scientific or popular element. That division of American Naturalists Society in which the American Association for the Advancement of Science meets should join with it in its meeting. Advocates strong national society for each of sciences, these to be divided into sections holding simultaneous meetings in geographical centers along with other scientific bodies affiliated with the American Society of Naturalists.

ARTHUR H. FORD (18 Mch., '04, No. 481, pp. 464–465).

Presents following plan to increase usefulness and influence: *Organization:* In addition to the present organization, establish a branch in each community where there are a number of members of the association. *Meetings:* In addition to the general meeting have each section meet once a year and each branch once a month, or oftener if profitable. *Publications:* Publish SCIENCE as at present, and in addition publish all papers presented at section meetings and the more important of those at branch meetings in the 'Transactions'; issuing a set of transactions for each section.

Best time for holding general meeting, at which social element should be emphasized, appears to be in early summer.

WILLIAM NORTH RICE (1 April, '04, No. 483, pp. 548–549).

Believes it is a mistake to change time of meeting from summer to winter. Inclemency of weather, inability to secure long vacation at this period, and love of home-life at this time are sufficient reasons. Believes it to be a good time for meeting of societies of restricted membership. Believes it to be a good plan to return to former arrangement.

ARTHUR HOLLICK (15 April, '04, No. 485, pp. 620–621).

Main province of association would seem, in future, to be that of organization and popularization of science. *Let summer meetings be continued* for purpose of arousing and maintaining popular interest and to serve as a common meeting ground for scientific and non-scientific men. Social element to be encouraged and get beginners and amateurs acquainted with older members. Open question whether winter meetings in addition are

advisable. Tendency to make these technical and it might be wise to encourage this idea. Let affiliated societies here take the leading position.

E. P. Felt (15 April, '04, No. 485, pp. 622–623).

Two general sessions of association ought to meet every demand at the meetings; one to mark the opening of the meeting, the other to give the president opportunity to deliver his address. Notices for each day could appear on program, thus allowing unbroken day. Morning meetings devoted to general papers. Afternoon meetings to special papers before subsections or societies. Evenings to sessions of members for short addresses on topics of general interest. We would favor the continuing of the complimentary lecture to the people of the city where the meeting is held. All evening meetings should close by 9:30, leaving time for banquets, etc.

W. J. Beal (20 Mch., '04, No. 490, pp. 797–798).

"Let association keep up all its sections, possibly adding to the number, freely cooperating with special societies, each section showing a willingness to unite in preparing a program with any one or more special societies having a like object." Years ago Professor Cope, Mr. W. A. Rogers and Mr. E. S. Morse objected to presentation of popular papers. I have recently thought it desirable to have a number of selected speakers present some topic or series of topics in a popular way to attract 'outsiders.'

3. "Education, economics, but not philology."

4. "Once a year, preferably in winter, till this date has had a fair trial."

5. "Meet most of time in populous regions from Washington to Boston, Detroit to Chicago, where many people are most sure to attend."

---

*AN ANALYSIS OF THE PHENOMENA OF ORGANIC 'POLARITY.'**

The so-called 'polarity' that is shown in the regeneration of animals and plants has always been regarded as an expression of a fundamental influence of the old upon the new growth. By polarity is meant in a general way that from the anterior end of a piece of an animal a new head regenerates, and from the posterior end a new tail. Many exceptions to this rule have been discovered in recent years, and in the light of these discoveries, I think, we are now in a position to undertake a more thorough analysis of the phenomena of organic polarity than was possible without these new facts to guide us.

I shall group the main points to be discussed under four artificial headings: (1) 'Regeneration when *no* Alternative Exists at a cut Surface,' (2) 'Regeneration when an Alternative does Exist,' (3) 'Regeneration when the Relative Rate of Growth Depends on Preformed Elements (Buds)' and (4) 'Lateral Regeneration.'

1. REGENERATION WHEN NO ALTERNATIVE EXISTS AT A CUT SURFACE.

If the tail of a tadpole is cut off a new tail regenerates at the posterior end of the tadpole. The tail that is cut off does not ordinarily regenerate at its anterior end, *because* it dies before regeneration can take place. If it is kept alive, either by grafting or by remaining partially attached, it regenerates from its anterior end, *not* a tadpole, but another tail, reversed in direction. The conditions are such that both at the anterior and at the posterior cut surfaces only a tail can develop. The new tail from the posterior cut surface is in the direction of the old polarity, while that from the anterior cut surface is in a reverse direction.

In the earthworm a similar condition has been found. If the worm is cut in two at any level behind the gizzard, both cut ends regenerate a tail. Anterior to this level, however, the posterior piece regenerates a head on its anterior end. It is

* Read before the National Academy of Science, November 16, 1904.

not improbable that the anterior piece also, if kept alive, would regenerate a head on its posterior cut surface.

I have obtained a similar result with the leg of one of the salamanders, *Spelerpes ruber*. If the foot is first cut off and then the skin of the foreleg is loosened, so that a piece of the internal parts can be cut out, and if this piece is turned round, and grafted in the pocket made by the loosened skin, there regenerates from the free end a new foot (and not a salamander).

A few other examples might be given, but these will suffice to illustrate the main points. The new part has in these cases only one possibility, and the same structure regenerates from the anterior and from the posterior cut surface, regardless of the 'polarity' of the old part.

The interpretation of these facts is, I believe, not difficult in the light of certain other results that are now known. Only one kind of structure develops because the group of new cells that appears over the cut end is such that out of it only one kind of organ can be formed. This may sound paradoxical, but my meaning will, I hope, be clearer when we have considered the next category, when an alternative exists.

2. REGENERATION WHEN AN ALTERNATIVE EXISTS.

The worm *Lumbriculus* furnishes the most striking instance of this sort. If the worm is cut in two *at almost any level* a head regenerates from the anterior end and a tail from the posterior end. Since the two cut ends are identical, each must have both potentialities. Nevertheless, a head forms at one end and a tail at the other. Planarians give the same results. Pieces of *Hydra* also behave in the same way. Another hydroid, *Tubularia*, often produces a head (hydranth) at one (apical) end and a stolon at the other; but also quite frequently produces a head at both ends. It has been shown, in fact, in all these forms, except *Lumbriculus*, that a head may regenerate on the posterior end under certain conditions.

Thus, if the apical end of *Tubularia* be tied or stuck into the sand, a head develops on the basal end. If a piece is sharply bent the same result happens.

If very short cross-pieces of *Planaria maculata* be cut out, a head often develops on both ends. If two pieces of hydra are grafted together by their anterior ends, one piece being longer than the other, the 'polarity' of the shorter piece will be reversed, and a single hydra regenerate.

Several recent writers have attempted to account for these cases of reversal on the old Bonnet-Sachs hypothesis that formative stuffs migrate in definite directions. Loeb, for example, has tried in a recent paper on *Tubularia* to rehabilitate this view, but, I believe, without success. During the past summer I have carried out a large number of experiments on *Tubularia*,* which I think show that the assumption of the migration of stuffs in definite directions is not needed to explain the results, and there is in reality nothing in the experiments to support such an idea.

It would take me too long to go into the details necessary to substantiate this statement; but in a forthcoming paper I shall hope to discuss the question more fully. It must suffice here to state that, in my opinion, the development of a head on the apical or on the basal end of *Tubularia* may be explained if we assume that the amount of nutritive substances present at a given moment represents one of the internal factors and the stimulus of the sea water on the *more responsive* free end (which is always that nearer to the old head) represents the external factor that calls forth the regeneration of the hydranths.

The third category applies only to plants.

* In collaboration with N. M. Stevens.

3. REGENERATION WHEN THE RELATIVE RATE OF GROWTH DEPENDS ON PREFORMED ELEMENTS.

If a piece of a willow be cut off and suspended in a moist atmosphere the apical buds produce new shoots (the basal buds hardly developing at all). Roots develop around the basal end of the piece from preformed root-buds. This phenomenon is so similar to what takes place in the regeneration of animals that the same term, 'polarity,' has been applied here also. Now I believe it can be shown that the phenomenon is not the same in the two groups and is the outcome of quite different factors. An examination of the results in plants will show that the first buds to develop are the most vigorous ones, which are usually the largest. In the case of the willow the largest buds are those nearer, although not at, the distal ends of the branches. If these buds once begin to develop they will use up the available food stuffs in the piece, and thus hold in check the development of the more basal buds. Hence the latter fail to develop. In some other plants the basal buds are the most vigorous ones and these develop first. Whether the same explanation will account for the root development can not be stated, because, so far as I can discover, no one has shown whether the root-buds nearer the base are more advanced than are those nearer the apex. If this should prove to be the case the explanation used for the shoots will also account for the development of the roots. These phenomena in the pieces of plants led Sachs to apply his stuff hypothesis to explain them. He not only assumed that formative stuffs are present, but also that they move, in response to gravity, in definite directions. His latter assumption was shown to be untenable by Vöchting. A number of recent investigators still continue, nevertheless, to make use of Sachs's hypothesis in one form or another. Goebel, for instance, intimates that the 'polarization' of the tissues themselves is the cause of some of the formative (or, in some cases, nutritive) stuffs moving in one direction and of others in the opposite direction. Thus, while Sachs started out to explain polarity as the result of fluids flowing in a given direction, Goebel, nominally using Sachs's view, assumes the polarity in order to make the substances flow in predestined paths.

I think we need assume neither formative suffs nor their movements in specific directions. I have stated above that we can account for the results by means of a simpler and, I believe, a more reasonable explanation.

4. LATERAL REGENERATION.

If we confine our attention to the regeneration of the head and of the tail alone we get a very incomplete conception of the phenomena that are to be included under the term polarity, for animals regenerate not only in the directions of the poles of a magnet, but laterally, dorsally, ventrally. In short, in all three dimensions of space, or combinations of them. One example of many that might be given will illustrate my point.

If a planarian is split lengthwise into two equal parts, each half regenerates laterally its missing part. If we examine carefully the method by which this takes place we find that a narrow edge of new material appears along the cut side and in this material the new structures are laid down. The chief point of interest here is that the lateral organs develop long before the new part has reached the size of the part removed. Furthermore, at the outer, new edge the distal ends of the branches of the digestive tract are produced, and along the line between the new and the old material the median organs are laid down. The intermediate parts

are at first much shortened, perhaps even undeveloped. Thus there is no building outwards of the new organs from the cut edge, but, on the contrary, the differentiation is in large part centripetal in direction. Pflüger thought that the regeneration of a new part may take place in somewhat the same way that a crystal grows in a saturated solution, but the case that I have just given shows that this conception will not explain the main facts,* although it is not to be denied that to a limited extent the old organs along the cut edge may have some influence on the formation of the new organs besides that of proliferating new cells.

The same points that are illustrated by the last case are even more strikingly shown in a piece cut off far out to one side. In this case the structures exposed along the cut edge are not median structures, yet the new median organs are here also laid down between the old and the new tissues. The old parts in this case can not be supposed to determine the formation of the median organs, as was possible in the former instance, but the entire process of differentiation in the new material is rather centripetal, *i. e.*, from the surface inwards. At least, if the actual differentiation is not in point of time from without inwards, the influences that determine the extent and kind of organs that are laid down must be thought of as acting in this way.

In these pieces that regenerate laterally a new head appears at the anterior end of the new material and a new tail at the posterior end. The position of the pharynx in lateral pieces removed from different levels of the body gives a clue to one, at least, of the internal factors that must be at work. If the lateral piece is from the anterior region of the worm, the new pharynx develops near its posterior end; if the piece is from the middle of the worm the new pharynx develops near the middle; and if the piece is from the posterior region the new pharynx develops near the anterior end. Thus the location of the pharynx gives us a clue to certain conditions present in the new part. An analysis of the results leads to the following conclusions:

1. The new material is at every level totipotent, as shown by the fact that a new head will form near the anterior end of a piece at whatever level the piece has been removed.

2. The new material although totipotent is not homogeneous, or, more technically, not isotropic, as shown, for example, by the position of the pharynx. We must conclude from this that the material is somewhat different at every level, and that this difference corresponds *in kind* to the character of the body at each level. Consequently there is in every piece a gradation in the new material from before backwards that gives us the phenomenon that we call polarity. With this difference, or polarity, as a basis the centripetal influence, acting from the surface inwards, determines the organization of the new part.* The action of this centripetal influence is on the new part as a whole, and determines the relative location of each organ.

By means of these three assumptions—of totipotence, of heterotropy and of organization-power—we can explain the main features in the result. Each assumption is, moreover, a direct deduction from an experiment or observation!†

This view will also account for the de-

* Pflüger's view does not explain those cases in the regeneration of a head or tail when the new part is shorter than the part removed.

* This idea of the action from without inwards was formulated by Morgan in 1899, and by Driesch more fully in 1900.

† The same explanation applies to the development of the egg.

velopment of a head at the anterior end and a tail at the posterior end of a cross piece of planaria, or of lumbriculus, or of hydra. In the planarians a head forms on the anterior end, because, on my view, the new material there is continuous with the new material throughout the old part and the difference in the character of the parts at each level gives the basis on which the organizing power acts. Similarly for the tail development at the posterior end. In *Lumbriculus* the same conditions hold. In both cases the old tissue may be so little differentiated that its regional differences may also furnish the basis for the organizing power to act. *Very short cross-pieces of Planaria maculata* often produce a head at each end. This result may be due, as I have explained elsewhere,* to the absence of sufficient difference between the ends on which as a basis the organization of the posterior end can take place. It must be assumed in this case that the external and internal factors, in the new part, have a stronger influence in calling forth a new head than a new tail—much as in *Tubularia*. In hydra no new tissue is produced at the cut ends, but the old part molds itself into the typical form. Here the old tissues are so little fixed that the organizing power acting along the lines of regional difference molds the old part into a new whole. In this respect the difference between hydra and the other forms is merely relative.

My view differs in many points from the stuff hypothesis. It assumes no specific stuff apart from the living material, and consequently it makes no assumption of the migration of such stuffs in multicellular organisms;† it assumes that the material at each level has in addition to its totipotence something also of the material basis characteristic of that level. Lastly, my view takes into account the organizing power of the living material which builds up its structure independently of cell boundaries on the basis of the totipotence and heterotropy of the new part. It is needless to point out further differences of minor importance.

Another example of lateral regeneration brings into the foreground the character of the organizing factors that are at work. If the arm of a salamander is cut off near the body new material appears over the cut end, and while the new material is still relatively small in amount (compared with the amount removed) a new limb, including parts of all the structures, is laid down. The humerus does not complete itself, and then the other parts form in order of succession from within outwards, but simultaneously the new material is proportionally subdivided or *segregated* into the typical elements. Subsequently the new parts all grow larger and longer, until the new limb reaches the size of the one on the other side.

The migration hypothesis is not needed in this case where no alternative exists to account for the location of the new part, and it is helpless to explain the phenomenon of segregation that takes place when the dif-

* 'The Control of Heteromorphosis in *Planaria maculata*,' *Roux's Archiv*, XVII., 04.

† It has been shown in the case of the egg of many forms (frog, sea-urchin, crepidula, ascidian) that movements of the protoplasm may occur. The differentiation that results appears to follow, to some extent at least, the regional differences in the protoplasm. Here we are not dealing with formative stuffs, in the original sense of the term, but with differences in the kinds of protoplasm, or perhaps only with quantitative differences, which become relegated to different cells. It is presumably the same differences of protoplasm in the cells of the fully formed animal that furnishes the basis for the regional differences in the new and old material in antero-posterior regeneration, etc., and which gives the basis on which the organizing changes go forward. In multicellular forms there is no extensive evidence of migration from cell to cell of the different kinds of protoplasmic materials, nor any necessity of making the assumption that they do migrate.

ferentiation occurs. In my view the material of the new stump is at first totipotent (at least for each kind of material); the surface and the ends of the old organs are the terminals between which the segregation of the new parts takes place.

Let us next turn our attention for a moment to the factors that determine the organization of the new structure.

The term *formative force* was formerly used to cover the changes that take place when the new organ 'crystallizes,' as it were, in the new material. Since no such force is known in the physical world, modern biologists have looked askance at the term. In one sense they are, of course, entirely justified in doing so, because no such creating force is known to us outside of the phenomena to be explained, and the term, therefore, only restates the changes and can not be used as a causal explanation of them. In another sense, however, the use of this term may come nearer to an expression of what is needed than any attempt to explain the results by known chemical or physical 'forces' or energies or principles; for it seems to me that we are dealing here with a phenomenon characteristic of living material—a phenomenon that is unknown to the physicist. This does not mean that I believe the phenomenon is not capable of a causal, *i. e.*, of a physical, explanation. In fact, I have every reason to believe it belongs to this category, but it is not a principle that the physicist meets with, or, at least, has yet met with outside of living material—unless, indeed, the so-called liquid crystals of Lehmann represent a similar phenomenon.

The term '*formative force*' is obnoxious also because of the dubious use of the word *force*. It has been pointed out that since no two animals develop in the same way, or regenerate identical structures, there would be as many kinds of formative forces as there are animals that develop or regenerate. In fact, there would be in *each* animal as many kinds of formative forces as there are *parts* that can regenerate. I believe the objection is well founded, at least, to the extent that it shows that we are not offering a causal explanation when we refer the phenomena to a formative force. On the other hand, no one knowing the facts can doubt that all the cases belong to the same general category; but since the composition of no two animals belonging to different species is the same we should not expect the egg or the newly formed materials to organize themselves in exactly the same way, although the *kind* of action may be the same in all of them.

We meet with the same problem in attempting to explain certain facts in inorganic nature. The salts of different substances crystallize each in its own peculiar way. It would, therefore, be just as misleading to speak of a *crystallizing force* as of a *formative force*, yet no one doubts that the crystallization of each salt depends on some property that all salts have in common.

We meet here with a philosophical principle that it would be out of place to discuss at this time, yet it is a point of as much importance to the practical, thinking experimentalist as to the theorist. I suggest that, for want of a better term, we may provisionally call the property of living material to assume a specific form the property of *formative organization*.

I may sum up my conclusions categorically as follows:

1. Where no alternative exists at a cut surface there is no question of polarity and we have simply to deal with the phenomenon of formative organization, which I would suggest, but can not prove, is in some way a phenomenon of contraction depending on the relative condition of tension in the parts.

2. When an alternative exists at the cut end we meet with the problem of polarity also. In the hydroid, *Tubularia*, an analysis of the conditions leads me to conclude: (1) That the hypothesis of stuffs moving in given directions does not explain the facts, (2) that the results can be accounted for on the ground of the amount of nutritive substance present in the pieces, taken in connection with the relative conditions of the stem at each level. Furthermore, in this case the stimulus of the water on the exposed end, calling forth hydranth regeneration, is an important factor in the result.

3. There is nothing in the phenomena to suggest that the old part has a stereometric influence, *i. e.*, a directive influence on the new part, as the term 'polarity' suggests. On the contrary, the influence is largely centripetal in direction, so far as there is any question of direction involved.

4. An analysis of the conditions present in lateral regeneration in planarians suggests that at least three separate factors are to be recognized in the changes that take place. I have put these factors into the categories of (*a*) totipotence, (*b*) heterotropy and (*c*) organization.

5. The ends of the old organs have also an influence on the regeneration, but a less important one in some cases than those just mentioned.

6. The same factors are also present in antero-posterior regeneration in which an alternative is present. When *no* alternative exists the totipotence has certain limitations, which depends, however, on the special combination of tissues in the new part, rather than on any limitations in each group of cells.

7. The organizing principle acts on the new and old part *as a whole* and determines the relative arrangement and proportions of the new organs.

T. H. Morgan.

Columbia University.

*MOSAIC DEVELOPMENT IN THE ANNELID EGG.**

Our general interpretation of the problem of development has been somewhat prejudiced by the fact that so much of the earlier experimental work dealt with such eggs as those of echinoderms, medusæ, *Amphioxus* or the nemertines, where any one of the first two or four cells may produce a perfect dwarf embryo; for such cases seem at first sight to be irreconcilably opposed to any theory of definite pre-localization or mosaic development. The collapse of the Roux-Weismann theory of differentiation by qualitative nuclear division discredited for a time the whole mosaic theory; but more recent experimental work, especially on the eggs of ctenophores and mollusks, promises to re-establish it on a new basis. In the course of the past year I have been able to show experimentally that the development of mollusks (*Dentalium, Patella*) conforms in its main features to the mosaic principle, and, furthermore, that the cleavage mosaic is foreshadowed by a very definite original pre-localization of specific protoplasmic materials in the undivided egg. During the past summer I have had an opportunity to extend these observations in some measure to the egg of an annelid, where the same general principle has been found to hold true.

The development of the annelids presents the problem in a very clear-cut form, since from the first cleavage onward the principal material of the segmented trunk-region lies in the posterior cell of the embryo, and this cell is in most species somewhat larger than the anterior, and hence may be immediately identified. The experiments here reported consist in a comparison of the development of the isolated posterior cell of the two-cell stage with

* Read before the National Academy of Sciences, November 16, 1904.

that of the isolated anterior cell, especially in the genus *Lanice,* which I have found the most favorable egg for operation of all the many forms tested. While the number of successful operations has been rather small, they have given a very definite result, and one that is in its main features in agreement with the one earlier obtained in the eggs of the mollusk *Dentalium.* When either cell of the two-cell stage is destroyed, the remaining cell segments as if it still formed a part of an entire embryo. The later development of the two cells differs in an essential respect, and in accordance with what we should expect from a study of the normal development. The posterior cell develops into a segmented larva with a prototroch, an asymmetrical pre-trochal or head region, and a nearly typical metameric seta-bearing trunk region, the active movements of which show that the muscles are normally developed. The pre-trochal or head-region bears an apical organ, but is more or less asymmetrical, and, in every case observed, but a single eye was present, whereas the normal larva has two symmetrically placed eyes. The development of the anterior cell contrasts sharply with that of the posterior. This embryo likewise produces a prototroch and a pre-trochal region, with an apical organ, but produces no post-trochal region, develops no trunk or setæ, and does not become metameric. Except for the presence of an apical organ, these anterior embryos are similar in their general features to the corresponding ones obtained in *Dentalium.* None of the individuals observed developed a definite eye, though one of them bore a somewhat vague pigment spot.

This result shows that from the beginning of development the material for the trunk region is mainly localized in the posterior cell; and, furthermore, that this material is essential for the development of the metameric structure. The development of this animal is, therefore, to this extent at least, a mosaic-work from the first cleavage onward—a result that is exactly parallel to that which I earlier reached in *Dentalium,* where I was able to show that the posterior cell contains the material for the mesoblast, the foot and the shell; while the anterior cell lacks this material. I did not succeed in determining whether, as in *Dentalium,* this early localization in *Lanice* preexists in the unsegmented egg. The fact that the larva from the posterior cell develops but a single eye suggests the possibility that each of the first two cells may be already specified for the formation of one eye; but this interpretation remains doubtful from the fact that the larva from the anterior cell did not, in the five or six cases observed, produce any eye. This subject remains for further examination, which I hope to be able to carry out hereafter.

These observations, in connection with my preceding ones on the molluscan egg, contribute to the growing body of evidence that the development both of annelids and of mollusks is to be regarded as a mosaic-work of self-differentiating cells; and, further, that the specific morphogenic factors are connected in some way with specific forms of protoplasm, which I think may conveniently be designated as formative (perhaps better, 'morphoplasmic') stuffs. I have endeavored in two recently published papers to show that the same principle applies to the eggs of other animals, even in such cases as the sea-urchins or *Amphioxus,* where either of the first two cells may produce a complete embryo. The explanation of the difference between the two cases appears to be that in the mollusk or annelid the cytoplasmic stuffs undergo an asymmetrical distribution during the first division, while in the sea-urchin or *Amphioxus* the distribution is symmetrical. The division is, therefore, in the first case

qualitative, in the second case quantitative only, thus giving the immediate possibility of the production of two embryos from a single egg. It appears to me that we find here a principle of reconciliation between the hypothesis of mosaic development and pre-localization, and the apparently contradictory one of non-mosaic or correlative differentiation. The facts show that each of these apparently contradictory hypotheses contains an element of truth; that we must recognize in the development of every animal the fact of pre-localization and of mosaic development, but also the fact of correlative action. The relation between these two can not be predicted, but must be determined in each individual case; for the known facts are already sufficient to prove that the segregation of the formative stuffs is a process that occurs at different periods in different animals. At the time of fertilization, accordingly, the segregation differs both in degree and in form; and these differences have not yet been reduced to any general law.

In conclusion, I would express the opinion that, so far as the early stages of development are concerned, it is difficult to escape the hypothesis of formative stuffs or specific morphoplasmic substances, in some form. But while this hypothesis facilitates an understanding of the *modus operandi* or immediate causes of differentiation, it leaves us as much as ever in the dark as to the localizing or form-determining factors which are responsible for the determination of the segregation pattern. This problem, which is essentially one of correlative action, is not only unsolved, but suggests the existence of specific energies for which it is difficult at present to find an analogy outside the field of protoplasmic action.

Edmund B. Wilson.

Columbia University.

SCIENTIFIC BOOKS.

Contributions to the Study of the Behavior of Lower Organisms. By Herbert S. Jennings. Published by the Carnegie Institution of Washington. 1904. 256 pp., 81 text-figures.

In the series of papers which make up this volume Professor Jennings presents results which are of fundamental importance for our understanding of the behavior of lower organisms. The titles of the seven papers of the volume are as follows: (1) 'Reactions to Heat and Cold in the Ciliate Infusoria,' (2) 'Reactions to Light in Ciliates and Flagellates,' (3) 'Reactions to Stimuli in Certain Rotifera,' (4) 'The Theory of Tropisms,' (5) 'Physiological States as Determining Factors in the Behavior of Lower Organisms,' (6) 'The Movements and Reactions of Amœba,' (7) 'The Method of Trial and Error in the Behavior of Lower Organisms.'

For the purposes of this review the papers may be separated into three groups. Of these the first, which includes the first three papers, is devoted primarily to descriptions of the modes of reaction of several of the lower organisms, and to a discussion of the bearing of these reactions upon the 'orientation theories' of Loeb and Verworn. The second group is constituted by the paper on Amœba; in it the author deals in detail, as a result of his own observation, with the mechanics of locomotion, modes of reaction and psycho-physiology of the organism. Papers four, five and seven are included in the third group. In addition to presenting several points of interpretation, they contain discussions of the relations of the author's results to the general theory of tropisms.

I shall now attempt to state briefly the principal points made in each of these three subject divisions of the volume.

In explanation of the directive influence of stimuli on the movements of various organisms Loeb, Verworn and others have proposed the so-called orientation theories.

According to these theories a stimulus which acts unequally upon different portions of the body causes inequality of contraction in the musculature, and thus brings about a turning

of the body either toward or away from the source of stimulation. The animal is perfectly oriented with reference to the stimulus when symmetrical points on the body are equally stimulated.

By careful observation of the behavior of several types of lower organism Jennings has determined to his own satisfaction, and judging from the nature of his descriptions with certainty, that the reactions of the unicellular organisms, and also those of some of the metazoa, are not in harmony with the current theories of orientation. The reaction of ciliate infusoria to heat and cold is thus described, in summary, by the author, "the response, on coming into a region where the temperature is above or below the optimum, is by backing and turning toward a structurally defined side, followed by a movement forward. This reaction is repeated as long as an effective supraoptimal or suboptimal temperature continues. The result is to prevent the organisms from entering regions of marked supraoptimal or suboptimal temperature, and to cause them to form collections in regions of optimal temperature. The common orientation of a large number of individuals sometimes produced in this way is an indirect result of the method of reaction. Since movement in any other direction than a certain one is stopped, the organisms after many trials come into this direction. Orientation is, therefore, by 'exclusion,' or by the method of trial and error" (p. 28).

Similarly the author has shown that the reactions of ciliates and flagellates to light are not in accordance with the assumptions of the theories of orientation.

Among the multicellular organisms the Rotifera, according to the observation of Jennings, turn as a rule toward a structurally defined side—the dorsal—without relation to the side stimulated most strongly, and continue turning, or alternately turning and darting forward, until the anterior end of the body is directed away from the source of stimulation. "Thus the direction of turning is throughout dependent upon an internal factor, not primarily on the way in which the stimulus impinges on the organism. These reactions of the Rotifera are thus inconsistent with a theory of tropisms which regards orientation as a primary feature of the reactions, and which holds that the action of the stimulating agent is a direct one on the motor organs of that part of the body on which it impinges" (p. 88).

Of the correctness of Jennings's observations there can be little doubt, for all his work is characterized by admirable care in observation and accuracy in description, but in criticism of the manner in which he discusses the bearing of his own results upon the orientation theories it might be said that he does not make sufficient allowance for the asymmetry of the organisms with which he worked. The fact that the various unicellular organisms and rotifers whose behavior is described in these papers do not orient according to the theories of Verworn or Loeb by no means proves that their theories are in principle wrong. Jennings's work does, however, very emphatically call attention to certain weaknesses and false assumptions of the theories in question, for their advocates have too often adduced the presumably well-known reactions of these very organisms in support of one or another form of the theory of the tropisms.

It is only fair to the author to state that his arguments are directed more especially against the 'direct action' assumption of the tropism theory than against the theory of orientation. He believes that his observations prove beyond a doubt, for the animals studied, that stimuli bring about reactions by their general action upon the organism rather than by direct local action, and he, therefore, contends with good reason that the theory of the tropisms as stated by Verworn, Loeb and others is radically wrong.

It is worthy of note, in connection with the facts of Jennings's studies, that the turning toward a structurally defined side which is so common among the unicellular organisms serves usually, although not always, to direct the organism away from the source of stimulation. For example, *Paramecium* turns towards its aboral side, hence away from the currents of stimulating substance which are drawn

toward the oral region by the ciliary movements. The same conditions obtain in the Rotifera, for there the ciliary current passes to the mouth, on the ventral side, and the organism, in case the current carries a stimulating substance, turns toward the dorsal surface.

Turning our attention now to the second subject-group, we find that Jennings undertook the study of the behavior of Amœba with two definite purposes in mind: (1) To determine how far recent physical theories explain the activities of the organism, and (2) to add to, systematize and unify our knowledge of the subject.

Fortunately the author did not confine himself to the unexplored regions of his field of research, but instead repeated the experiments and attempted to verify or replace the so-called facts of other investigators, and test their theories.

The results of this thorough reinvestigation of the subject are in many respects startling. In the first place, Jennings finds that the descriptions of the protoplasmic currents within the moving Amœba given by Bütschli and Rhumbler are not true to the facts. These investigators have stated that there is a forward-moving axial current and a backward-moving surface current at the sides of the animal, the conditions in the organism being practically the same as that in a drop of inorganic substance whose surface tension is decreased at some point. Jennings has been able to demonstrate to his entire satisfaction by the use of several simple methods that there is only a forward current. As this is an important matter we may appeal to his excellent description of the observations. "In an advancing Amœba substance flows forward on the upper surface, rolls over at the anterior edge, coming in contact with the substratum, then remains quiet until the body of the Amœba has passed over it. It then moves upward at the posterior end, and forward again on the upper surface, continuing in rotation as long as the Amœba continues to progress. The motion of the upper surface is congruent with that of the endosarc, the two forming a single stream" (p. 148).

This is of special interest because it sweeps away one of the principal supports of the surface-tension explanation of the movements of Amœba. And it may well be added here that Jennings's methods are so much superior to those employed by many of the earlier investigators, and his observations so much more detailed, that his results will almost undoubtedly be verified by others shortly.

After a minute study of the formation of pseudopodia, the reactions to stimuli, food-taking, and several other interesting features of the behavior of the organism, the author formulates the following general conclusions with respect to the mechanism of movement: "Altogether, then, our results lead us to look upon Amœba as an elastic and contractile sac, containing fluid. In locomotion one side of this sac actively stretches out, becomes attached to the substratum, and draws the remainder of the sac after it in a rolling movement. The primary phenomena are the stretching of one side, the elasticity, and the contractility of the outer layer" (p. 172). The author does not attempt to account for the pushing out of the anterior edge, nor does he theorize concerning the nature of the contractility of the ectosarc.

Perhaps the most important general results of the study, so far as the views of the author are concerned, is that it shows pretty conclusively that we have not thus far succeeded in analyzing, as Bütschli, Rhumbler and others appear to think they have done, the behavior of any organism to the point of complete physical explanation. After all the external factors have been taken into account there appears still to be a necessary factor or complex of factors which have to be referred to the organism itself. External physical factors apparently suffice for the description of certain of the activities of the lower organisms as well as of the higher; but usually critical research shows that the descriptions are not complete. As Jennings remarks, 'Putting all our results together, we must conclude that the movements and reaction of Amœba have as yet by no means been resolved into their physical components' (p. 225).

In the third group of papers the author

brings out forcibly the fact that almost every reaction of an animal involves or is conditioned by the activity of the total organism. The tropism theory is misleading in so far as it seems to suggest that local action, largely independent of the conditions of the body as a whole, is the common rather than the exceptional determinant of reaction. In this portion of the volume it is evident that Jennings is emphasizing the unknown factors in animal behavior, while at the same time severely criticizing those observers and theorists who contend that they can reduce organic activity to physical factors.

Trial and error is the method of adaptive reaction which is most frequently observed in the lower organisms. In a discussion of this topic the author is drawn into a discussion of the meaning of 'error': "There is no common thread running through all the different agents which constitute 'error' in the reaction, save this one, that they *are* error from the standpoint of the general interests of the organism. * * * Why do we receive without opposition certain chemical stimuli and avoid others? The facts are quite parallel in man and in the lowest organisms in these respects. * * * In both cases the stimuli producing the negative reaction are in general injurious to the organism (p. 247).

"In ourselves the stimuli which induce the negative reaction bring about the subjective state known as *pain*, and popularly we consider that the drawing back is due to pain. Is there ground for this view? Or is the reaction entirely accounted for by the chemical and physical processes involved? * * * If we hold that in man we can not account for the reaction without taking into consideration the pain, then we must hold to the same view for the lower organisms. * * * Any one who holds that we can account fully for the reactions of *Euglena* or *Paramecium*, purely from the physico-chemical conditions, without taking into account any states of consciousness, must logically hold that we can do the same in man. The method of trial and error implies some way of distinguishing error; the problem is: How is this done? The problem is one, so far as objective evidence goes, throughout the animal series" (p. 248).

The criticism of this volume, as of many of Professor Jennings's other writings, that one is first inclined to make is that there is needless repetition, that the same simple facts are described and redescribed until one almost feels it an insult to intelligence. But this is a judgment which the author has passed upon himself, for he has elsewhere stated that he describes all his observations in almost painful detail in order that investigators who have cause to use his results may not have the disagreeable experience, that has been his often, of failing to find in the description of experiments some little point that is important for the problem in hand. Apart from its repetitions, the volume is well written; it is also well printed.

As to the content of the work, it may be repeated that the evidences of thoroughness, accuracy, fairness to other investigators, freedom from overhasty generalizing, are such as to inspire great confidence in the results, and to warrant one in believing that they will serve to advance our knowledge of the general subject of animal behavior in a very important manner. In fact, it is not at all improbable that they may necessitate important modifications in the tropism theory.

ROBERT M. YERKES.
HARVARD UNIVERSITY.

RECENT BOOKS ON ECONOMIC AND SOCIAL SCIENCE.

Principles of Economics, with applications to Practical Problems. By FRANK A. FETTER, Ph.D. New York, The Century Co. 1904.

The United States and Porto Rico, with Special Reference to the Problems Arising out of our Contact with the Spanish-American Civilization. By L. S. ROWE, Ph.D. New York, Longmans, Green & Co. 1904.

Problems of the Present South. By EDGAR GARDNER MURPHY. New York, The Macmillan Company. 1904.

Russia, Her Strength and Weakness, A Study of the Present Conditions of the Russian Empire, with an Analysis of the Resources and a Forecast of its Future. By WOLF VON SCHIERBRAND, Ph.D. New York, G. P. Putnam's Sons. 1904.

America, Asia and the Pacific, with Special Reference to the Russo-Japanese War and its Results. By Wolf von Schierbrand, Ph.D., with thirteen maps. New York, Henry Holt & Co. 1904.

Greater America. By A. K. Colquhoun, F.R.G.S. With Maps and Diagrams. New York, Harper and Brothers. 1904.

Dr. Fetter's 'Principles of Economics' will rank high as a text-book. In technical equipment and class-room experience few men are better fitted than he. The most valuable parts of the book to the student of theory are to be found in those chapters in which he has recast many of the conclusions of economic thought, based on a much wider scope of generalization than is usually credited to earlier writers on economic principles. There is also a larger blending of the historical with the scientific method of treatment; the author has, therefore, been able to work out the various theories far more in harmony with facts than many of his predecessors have done. He has also shown the effect of statistical material upon the statement of principles. On the whole, his hope has been realized—'to further sound economic reasoning and to extend among American citizens a better understanding of the economic problems set for this generation to solve.' There are some parts of the volume, however, which, like the early words of the foregoing quotation, leave one in doubt as to just what is meant.

Dr. Fetter treats the subject from a standpoint of the study of values, as constituting the core of economic science. Values, according to his view, have an objective as well as a subjective aspect, and his classification is divided into three main heads: Values of material things, of human services, and social aspects of values, under each of which are a series of subheads, as indicated by the following outline:

I. Value of material things: Wants and present goods, wealth and rent, capitalization and time-value.

II. Value of human services: Labor and wages, enterprise and profits.

III. Social aspects of value: Relation of private income to social welfare, relation of the state to industry.

The measure of success is highly encouraging in the effort to apply principles to the discussion of problems. The questions and critical notes add materially to the value of the volume, showing that the author has fully appreciated the position of the student.

From the standpoint of scientific method less can be said. There is much more to be done before economic science, in the United States especially, shall have shifted its center of gravity from theoretical speculation to strictly scientific research. At the present time there is a great deal of restlessness at the barrenness of economic science, largely due to the too general prevalence of the speculative methods of treatment.

Economists, as a rule, have not felt called upon to be scientists; they have more often played the rôle of speculative inquirers, of economic philosophers—of privileged thinkers in a field over which their authority has gained in proportion to their regard for facts, rather than for theories applied to conditions which no longer exist, or which exist in no such degree as the theories imply. Thus it happens that chemistry, technology, geology and other sciences of economic content have gradually undermined popular confidence in economists. In many cases the engineer, for example, is more of an economist than the most orthodox professor of economics, because *his* judgment, and not that of the economist proper, has guided economic development.

'The United States and Porto Rico,' by Professor L. S. Rowe, of the political science faculty, University of Pennsylvania, and lately of the Porto Rican Code Commission, deals more generally with the political aspects of American influence in the West Indies. His volume has special reference to the problems arising out of our contact with Spanish-American civilization. While it is true that he looks at the subject chiefly from the legal standpoint, he has brought into order clear recognition of the social and economic conditions which have dominated government. The author shares the national hopefulness, as expressed in the final paragraph:

Whether we view the progress of the island from an industrial, political or social standpoint, the conditions are singularly favorable for the successful solution of the new problems presented by our Spanish-American possession in the Caribbean. The lessons that we are learning will be of service to us in the larger tasks that are before us. Future generations will look upon the experience acquired in the administration of civil affairs in Porto Rico as a period of training and preparation for the problems involved in our relations with the Spanish-speaking peoples of the American continent.

The chapter on 'The People' is most instructive. Of the population two fifths are colored, the island having a larger proportion of whites than most of the southern states. Three fifths of the people are engaged in agriculture, and the average *area per farm* is 45 acres compared with 146.2 acres in continental United States. Illiterates constitute 22.7 per cent. of the population, excluding all under ten years. An educational test, if applied to suffrage, would have excluded 76 per cent. of the males. The island's revenue is $2,500,000 (1903). Of the total income, local and insular, 28 per cent., or over one fourth, is applied to public education—an unusually large proportion, probably larger than that of any other community.

'Problems of the Present South, or a Discussion of Certain of the Educational, Industrial and Political Issues in the Southern States,' by Edgar Gardner Murphy, of Montgomery, Alabama, is a statement of the *rationale* of the southern policy in relation to the great pivotal questions of modern society, such as democracy, education, nationalism, industrialism, culture and the race question. Mr. Murphy succeeds well in his task. He has done good service in bringing thoughtful people back to the idea that the south is not attempting to solve its great social problems in a way which is out of line with national aspiration.

The chapters on the 'Schools and the People' and 'Constructive Statesmanship,' as well as that on 'Culture and Democracy,' must convince the reader that here is one at least who interprets southern life in the light of its faith in the progress of the people as a whole. The author seems to have made good use of statistical resources generally. There is some doubt, however, as to the value of the statistics of the census of 1870, many of which are confessedly unsatisfactory, so far as they relate to the southern states. Nor is it quite right to charge up the loss of private property through emancipation as a total loss to the south as a whole. The value of the slave population to the community was transferred from private account to public account, though the transfer caused a considerable depreciation in value, it is true, especially at the start. The great loss in economic resources came through the destruction of war and not through emancipation.

An instructive part of the exposition here given is that which relates to the growth of cities in the south. The author speaks very appropriately of the population of the southern states as being under-municipalized. The fact that the population of the south is predominantly rural, renders all the more formidable the problem of illiteracy. As he points out, however, the schools, in spite of all their difficulties, are gaining on illiteracy. There is not a state in the south which is not largely reducing its illiteracy. Within the years 1880 to 1900 there was a marked progress in this respect. In New York and Pennsylvania and Massachusetts the total number of male illiterates increased perceptibly within this period. Illiteracy, therefore, is not a sectional, but a national problem; more than six millions of our people can not read and write. In the chapter on 'Industrial Revival and Child Labor' the author cuts the ground out from under the opponents of constructive legislation by regarding children as an educational rather than as an industrial asset.

Wolf von Schierbrand's volume on 'Russia, Her Strength and Weakness,' is a vivid description of economic and social conditions, studied from the standpoint of Russia as an expanding world power. While the work is highly instructive, in fact one of the best short volumes on this most interesting people, some of its statements evidently need qualification. It is a mistake, for instance, to say that there has not been any industrial

progress in Russia for the space of one hundred and fifty years. The author deals intelligently with Russia's relation to Asia. It is the trend of this part of imperial policy which, in his view, shackled economic progress in European Russia.

In the light of the increasing national debt, Russian finances are analyzed and the effect shown of the debt upon the industrial development of the country. Numerous foreign loans have made it necessary to export more largely than ever in order to pay the interest on public obligations. Lack of private initiative has made it necessary for the government to enlarge its economic functions by absorbing its industries, transportation facilities and such mercantile pursuits as the liquor traffic. The extensive borrowing from abroad has brought into the industrial life of Russia a large number of captains of industry of foreign origin. These industries are, therefore, grafted upon from outside, rather than an organic growth from within the nation; hence they are of an unsatisfactory character from the standpoint of profits. Not only has industry suffered severe relapse, but agriculture, still the essential feature of Russian enterprise, finds nearly every one of its economic features exhausted. The peasant population as well as the landlords are without the surplus return necessary to keep up the land, the soil of the black belt is decreasingly remunerative and peasant wages average ten cents per diem—an index to growing poverty.

The decay of the nobility has left rural life without its earlier leadership. Absenteeism is a curse here, as formerly in Ireland. The church is no longer the vitalizing force in the life of the people and their morals it might be reasonably expected to be. Much is anticipated from the growth of a middle class. The government finds itself between the nether millstone of internal strife and the upper millstone of endeavor to Russify the foreign population. The course of progress is checkered by the ruling classes aiming to get control of the bureaucratic system, each to carry out a different program.

The chief reforms needed, according to this analysis, are the abolishment of the Mir, enlargement of the powers of provincial chambers and greater local autonomy.

This book is strikingly similar in narrative and incident, to the excellent volume of von der Brüggen entitled 'Das Heritige Russland,' published a few years ago in Germany. Probably the main criticism of the book is that the author has used his observation admirably, but has not equally well cultivated the art of appreciative insight.

In the classification of our libraries there is a rapidly increasing output of books on the subject of the world's politics. The center of interest in this sphere of international activity is invariably found in the subject of markets. Industrially equipped as national society is now, each of the leading industrial powers is interested in enlarging its foreign markets. If in ten months the industrial equipment of such a nation can supply enough for home needs in any particular commodity, this particular industry has before it the alternative of two months of idleness or of finding markets capable of absorbing the surplus. The former alternative spells industrial depression; the latter, commercial expansion. This is the argument as applied to the United States, which pervades von Schierbrand's recent volume on 'America, Asia and the Pacific.' His thesis is by no means novel—'that the Pacific during this century is bound to become what the Atlantic was during the eighteenth and nineteenth and the Mediterranean during the twenty-five centuries preceding.' For the rôle of leadership the competition lies among Great Britain, Russia, Japan and the United States. "The United States is the nation best equipped for the coming race in the Pacific. American expansion in the Pacific is something absolutely necessary to safeguard our further national development, and to preserve us from the curse of the ill-balanced production and all its attendant evils." The peg on which the author hangs so many arguments in the grouping of his facts is the Panama Canal.

It is useless to talk about our commercial supremacy in the Pacific, which is the author's major theme, with the insignificant ocean-going tonnage now afloat under the American flag. There is no economic justification for

this vaunting ambition to rule the seas. As one of the elements of the Pacific problems this deficiency in a merchant marine is being recognized, but not by any means with deserving importance, as part of the program laid down for the author's adopted country to follow. In this view it is naval efficiency, not a merchant marine, which shall dominate in the development of the Pacific and of the people on its shore frontage east and west. Is it not, however, a strange reversal of economic reasoning to say that, given a navy, a carrying trade will follow?

Moreover, out of the few lines of shipping of American registry it is the exception to find one that is on a sound paying basis. This is particularly true of lines on the Pacific. The fact is that a naval policy such as the United States is now carrying out only indirectly contributes to the creation of a merchant marine. It has resulted in developing the industry of iron and steel shipbuilding and thus contributed to the reduction of the initial cost of inaugurating this industry. But it does not seem to have reduced the comparative cost of producing ships at home. It has likewise created a prestige for the country and thus for its commerce in foreign parts. But apart from these advantages of a subsidiary character, a big navy is no guarantee of a big carrying trade on the ocean. It is quite too much to assume, as the author does, that with a navy the revival of our shipping will come of its own accord (p. 315).

The public must nevertheless recognize in this volume a penetrative insight into the economic possibilities of Russia in her relation to the United States. Possibly most recent books on Russia have been written from the official car-window standpoint. Here the chapter on 'Little Known Facts about Russia' (pp. 128–139) is worth whole volumes of sophomoric travels.

Russia's conquest by railroad has been for the purpose of opening an ice-free port and of closing Asiatic territory against foreign trade, the more effectively to control the economic processes of her internal policy. From this basis her influence in the Pacific as a competitor with the United States has to be foreshadowed. "It is quite safe to say," says von Schierbrand, that, "as economic enterprises, these Manchurian roads will prove even more pronounced failures than the Transsiberian has so far proved. Viewing them merely from the angle of Russian aggressive policy, of military strategy, and as a visible sign of Russia's expanding political power, they may, however, prove a success. On the other hand, even in this limited sense, they may eventually become a white elephant for Russia. The final issue of this present war will determine that question. For a country so poor in capital as Russia, a country with a home population whose most crying material needs are insufficiently supplied, these Manchurian roads are, economically considered, a gigantic folly."

Nevertheless, by a system of rebates on exports and of bounties in the form of reduced railway rates to the frontier, Russia has again and again succeeded in establishing and holding a footing in some of the markets supposed to be largely in control of her competitors. Hence the author probably takes too short a period of time into account as the basis of this conclusion.

Colquhoun's 'Greater America' is an incisive analysis of the subject of geographical expansion of the United States and the political and economic problems and responsibilities arising therefrom. Whoever has read his 'Mastery of the Pacific,' 'China in Transformation' and 'Overland to China' will recognize the well-reasoned weighing of essential facts and relations in which this work abounds. The shifting of the center of gravity of world politics from the Atlantic to the Pacific has everywhere raised the question, What part shall America play? 'Greater America' is more than continental United States; Greater America is a world power with problems of imperial importance upon her hands. It is in this latter rôle that a new class of social and economic problems is presented to the United States. They include political questions of foreign relations, of relations with alien peoples, of national defense, of government of dependencies. All of these in the author's view depend for right solution

on the efficiency and purity of administration. The *social* problems of America, as he presents the case, center chiefly around the worship of the golden calf (p. 4). The racial problem, the practical stagnation of the native born and the rapid increase among the poor aliens, make it advisable to take steps to preserve the ascendency of the Anglo-Saxon type of America (p. 6). Otherwise an undesirable modification of national character will take place. The nation is now indescribably heterogeneous. At a time when its larger tasks require internal unity and progress (p. 23) the nation is harassed with problems of racial relations. With the Indians the result has been far from satisfactory. With the negroes, the racial adjustment is a 'burning' question. The only solution offered is educational; but American education is materialistic in its trend—a statement to which exception might well be taken. Instead of unity we have an ever-widening gap between capital and labor (p. 35).

In the chapter on America and colonization, the six motives of colonization are classified as trade, conquest, adventure, overflow of population, religious persecution and political rivalries—all of which have to some extent figured in the territorial expansion of the United States, from the Atlantic seaboard across the continent, thence to Alaska, to Hawaii, Samoa, the Philippines and Porto Rico, giving rise to two great extensions of control: (1) Pacific expansion and (2) Caribbean expansion. In both of these the greatest problem is that of dealing with alien races.

In the Philippines the author contends that our idealism has led us to overlook the common sense requirements of the situation (p. 111); the Philippines wanted peace, good government and commercial prosperity; America has given them institutions and legislation; after three years' occupation not one yard of railroad has been begun; only one wagon road is in process of construction; no canals nor deepening of rivers has been undertaken, nor any improvement of harbors, except at Manila (p. 109). This seems to be rather a one-sided judgment. Certainly the Philippines have been given peace. Certainly the best government they have ever had has been given them, and the basis laid for commercial prosperity by the settlement of the land question, which was one of the chief causes of the revolt under Spanish rule.

In the Caribbean expansion of the United States, Cuba and Mexico are the two great considerations. The economic dependence of the one and the economic absorption of the other will be accelerated by the construction of the Panama Canal. But the problematic aspect of Caribbean expansion is the fate of the holdings of European states in this part of the world.

'Great Britain apparently can not help her island colonies. America does not want them.' The trans-isthmian canal, however, enhances their value to the owners of the West Indies, strategically. The hope of closer affiliations with Canada is still regarded as a realizable solution, because the two countries are economically complemental. For Great Britain the Caribbean question is a crucial one. Will these islands between the upper millstone of American indifference and the nether millstone of British inability to give them economic prosperity ultimately fall under the control of America? Cuba the author regards as so incapable of working out her economic salvation that without American energy and capital the island can not be developed. But though the United States gave Cuba education and sanitation, she has not been able to emancipate herself from an economic depression which may yet force the island to seek incorporation into the Union. "Are the other Caribbean islands to go the way of Cuba?" (p. 190). Are the Central republics to pass within the sphere of American control? And if so, what stands in the way of a still wider sweep of Pan-Americanism embracing Canada and the southern continent? In the chapter on Canada and Pan-Americanism the commercial situation is considered as requiring that people to have reciprocity either with the United States or with Great Britain. The United States rendered futile two earnest efforts by Canadian commissions (1891 and 1896) to establish reciprocal trade relations with us. Meanwhile the trend of Canadian

economic development has been toward closer relations with Great Britain and away from the United States. Now if reciprocity is wanted it has to be paid for at a higher price. Great Britain is bending her efforts to aid Canada in her ambition for economic independence of the United States.

One of the ominous signs of the times is the increasing dependence upon navies as a factor in commercial competition. "There can be no question that naval expansion is the dominant note in world policy to-day." Here we are brought face to face with the purpose for which this book was written, namely, to rouse America to the realization that her scope of development as a commercial power in the Pacific depends on her attitude toward the Russian policy of territorial expansion over Chinese territory. Russia's ambitions "may be briefly summed up as being chiefly inimical to the United States in that they are essentially monopolistic. * * * Russia with her program of territorial expansion, military achievements, closed ports, autocratic government and non-progressiveness is a menace to the world" (p. 358).

The assured sovereignty of China seems to be the only basis of permanency to far eastern peace and prosperity (p. 381). The breaking up of China would jeopardize Japan's position, because it would mean an ascendency of Russia and her sympathizers, Germany and France. In our author's view Russia's advance long since passed the defensible limit where British and American interests are impaired. These two interests he groups under the term Anglo-Saxon, and asks:

> What course can be suggested which would best serve the interests of Anglo-Saxondom? * * * Were her expansion the legitimate expression of internal growth and progress, as has been that of the United States, it would be unreasonable to adopt a hostile attitude towards it. Even from the point of view of ethics the territory hitherto conquered or annexed by Russia is probably better off under her than under half savage khans. But Russia's expansion is no longer legitimate. She has reached her objective, the Pacific Ocean, and has not paused to develop or organize the vast territories she has occupied; she has in no case laid the foundation of a future of freedom and prosperity for the conquered peoples. She has already imposed a cast-iron system and planted military colonies to keep things in order. She has no excuse save her own insatiable ambition and land hunger.

JOHN FRANKLIN CROWELL.
WASHINGTON, D. C.

SCIENTIFIC JOURNALS AND ARTICLES.

IN the November number of the *Botanical Gazette* Edward C. Jeffrey describes a new fossil sequoia from the Auriferous Gravels (Miocene) of the Sierra Nevada Mountains. He emphasizes his previously expressed view that the sequoias have originated from the Abietineæ.—George H. Shull publishes the results of his second season's study of the place-constants for *Aster prenanthoides* at Clifton, Ohio. This second collection was made in 1903 from the same area that supplied material for a quantitative study in 1900. The bracts, rays and disk-florets were studied quantitatively and the results compared with those of the earlier study.—B. L. Robinson describes 'A New Sheep Poison from Mexico,' which proves to be a new species of *Bouchetia*.—Elias Nelson publishes three western species of *Agropyron*.—Conway MacMillan describes some very interesting British Columbian dwarf trees. They grow on the rocks close to the sea but outside the influence of the surf, and represent three species: *Picea sitchensis*, *Tsuga heterophylla* and *Thuja gigantea*. One of them was less than two feet high and was 68 years old; another less than a foot high was 86 years old; and the third about a foot high, with a trunk one inch in diameter, was 98 years old.—A. C. Life describes some interesting results from an injury to *Ambrosia*, the chief result being that the primordia usually producing stamens and ovules produced vegetative shoots.

WE learn from *The British Medical Journal* that arrangements have been made with the Syndics of the Cambridge University Press to begin the issue of a *Journal of Agricultural Science*, under the editorship of Messrs. T. H. Middleton, T. B. Wood, R. H. Biffen, and A. D. Hall, in consultation with other gentlemen. The journal will publish only definitely scien-

tific work in agricultural science, and will not include the results of the ordinary trial of manures and varieties for demonstration or commercial purpose. It is proposed to issue the journal as material accumulates, aiming at quarterly parts of about 100 royal 8vo pages, four parts to constitute a volume. Among those who have promised to support the journal are: Professor H. E. Armstrong, F.R.S., Professor M. J. R. Dunstan, Dr. Bernard Dyer, Professor Liveing, Mr. A. E. Shipley, Dr. J. Augustus Voelcker, and Professor Marshall Ward. The first number will be published in January, 1905.

SOCIETIES AND ACADEMIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 589th regular meeting was held October 29.

Father Hagen, of the Georgetown Observatory, gave an account of 'Astronomy and Mathematics at the International Congress of Arts and Science,' speaking of the papers read, the persons present, the exhibits in various parts of the grounds and the formal and informal gatherings. Two great European congresses held just previous to that at St. Louis kept away many of the expected visitors.

Mr. C. E. Van Orstrand, of the Geological Survey, then presented a paper on 'A Load-Strain Function for Finite Strains.' The results of numerous experiments were summarized as showing that the load-strain curve is in general convex to the axis of loads, although in some instances there is one point of inflexion. Since matter is indestructible, the ordinates of the curve between the points of rupture for tension (x_t) and compression (x_c) are necessarily finite and positive. Hence the load-strain function can contain no zeros and no negative values between the limits x_c and x_t. There is a point of discontinuity at x_t, and for certain substances there may also be a point of discontinuity at x_c. Functions satisfying these conditions were defined by means of the function-theory. A special form of the most general equation is

$$y = (be^{c(x_t - x)^n} + k)^{-p},$$

where $y =$ strained length and $x =$ applied load.

For the case of perfect elasticity, $x_t = +\infty$, and a particular form of the equation is

$$y = e^{cx},$$

a relation which has previously been deduced, but by a wholly different method.* It was shown that this equation represents the data of observation to a high degree of accuracy within the limits ordinarily defined as perfectly elastic. The materials selected were vulcanized India rubber† and various kinds of metallic wires.‡

A letter from Dr. Becker was read expressing his appreciation of Mr. Van Orstrand's investigation.

Mr. C. W. Waidner, of the Bureau of Standards, gave the results of numerous determinations by himself and Mr. G. K. Burgess, of 'The Temperature of the Electric Arc.' A photometric method was used based on Wien's law and the instruments were calibrated at higher temperatures than had been done heretofore, so the uncertainty from extrapolation was reduced; the results were very accordant and gave about 3700° C. An increase of 70° to 80° was found when the current forming the arc was raised from 15 to 30 amperes.

Charles K. Wead.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

The 158th meeting of the Society on November 9 had the following regular program:

Mr. S. F. Emmons spoke of copper ores in Carboniferous limestone in the region of the Grand Canyon of the Colorado, some of which he had an opportunity of visiting during the past summer. Their origin had been ascribed to the leaching of the copper from the red sandstones which once overlay them but are now eroded away. He used these occurrences as a text to discuss the general question as to whether the widespread occurrences of copper in the Permian and

* 'The Finite Elastic Stress-Strain Function,' Dr. George F. Becker, *Am. Jour. Sci.*, 1893.

† Watertown, 'Tests of Metals,' 1893.

‡ 'Ueber das Gesetz der elastischen Dehnung,' J. O. Thomson, *Ann. d. Phys.*, **3**, 1891.

Triassic beds may be more properly considered as of contemporaneous formation with the enclosing beds, or whether they are later concentrations or may have been brought in from some entirely foreign source.

Dilation Fissures and Their Contained Ores. MR. W. H. WEED.

Dilation fissures are the fractures formed by expansion or dilation of a rock mass, as in the alteration of peridotite or other basic rocks to serpentine, a change involving an increase of volume of 20 to 33 per cent. The resulting rock is checked by minor fissures, and often accompanied by crushed areas and by larger fractures with persistent course, slickensided walls and polished balls and shelly serpentine. The lesser fractures extend to relatively shallow depths. The larger are trunk channels for circulating waters. Serpentinization appears to be due to deep-seated ascending waters. Chromite, various nickel ores, and in Italy and Cuba, copper ores (chalcopyrite and pyrrhotite) known to exist in small quantity in the unaltered rock, are presumably dissolved by serpentinization processes and deposited by filling and replacement along the fissures and crushed masses, forming ore deposits.

Evidence of Caves of Put-in-Bay, Ohio, on Question of Land Tilting. MR. M. L. FULLER.

The caves of Put-in-Bay have been long known to the public, but, with the exception of Mr. E. L. Mosely, no one seems to have discussed the evidences which they present as to recent changes of lake level. Daussa's Cave is probably the one which Mosely visited. In this cave there is an underground lake 80 feet long and 40 feet wide, which is connected with and fluctuates with the waters of Lake Erie. The water is several feet deep and on the bottom may be seen a number of stalagmites, mostly broken and discolored as if of considerable age. These submerged stalagmites, which are of open air formation, indicate a rise of the lake water level relative to the land. Three other caves, Perry, Crystal and Paradise were visited during the past summer. Perry Cave is a solution cavern, notable for its broad, low arch, 200 feet or more in diameter, and 5 to 7 feet high. Crystal Cave is an immense geode, 10 to 15 feet in diameter, lined with crystals of celestite up to a foot or more across. Neither of the caves throw much, if any, light on the problems of change of level. In Paradise Cave, however, which has been only recently opened, the stalactites are still preserved and afford more definite evidences. In this cave the stalactites, which are still dripping, are pendant from a sloping roof which dips beneath the surface of an underground lake connected with Lake Erie. There is no break in the stalactitic group between the portions above and below water level, indicating them to be essentially contemporaneous. The fact that those beneath the water level are practically as long as those above would indicate that the submergence was of so recent date that no material addition has taken place to those in the open air since the change of level. The submergence of the stalactites simply indicates a change of level of the lake waters relative to the land and does not in itself afford positive evidence of tilting. The occurrence of submerged tree stumps and other accordant evidences, all testifying to a similar change of level, seem to point to the tilting movement, established by Gilbert as a little less than half a foot to a hundred miles per century, as the cause of the submergence indicated by the stalactites of the caves.

GEO. OTIS SMITH,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON.

THE 389th regular meeting of the society was held on Saturday evening, October 22, 1904. The following communications were presented:

The Insect-Catching Grass of Cuba. E. A. SCHWARZ.

With the beginning of the rains in Cuba, countless swarms of insects appear. At this time also, a grass becomes common, which catches multitudes of the insects in its flowering spikes. They are caught day and night, and in incredible numbers.

The spiny involucre of the spikelets of the

grass presents a bristling array to all comers. Wings of insects alighting or flying within reach are pierced and entangled by the minutely barbed spines and become inextricably matted. Sometimes an insect is caught by the leg. It is not the weak insects only which are caught. Numbers were caught of *Pyrophorus noctilucus* Linn., a luminous snapping beetle, so large and strong that it can be held in the hand with difficulty. While most insects can not free themselves once they alight on this grass, two large ones do so with impunity, an earwig, *Apterygida linearis* Esch., and a bug, *Œbalus*. Minute insects are not caught, and no Orthoptera or Lepidoptera. There seems to be no possible advantage to the grass in its capture of insects.

The grass is *Cenchrus echinatus* Linn., a great pest in the rich soils along the edges of sugar cane fields. It is found in the West Indies and in southern Florida.

A Very Curious Plant from Mexico. J. N. Rose.

The plant in question is a large pumpkin-shaped object, or giant puff ball, somewhat flattened, with the bark of an oak. A few weak roots from the under side form a connection with the ground. The upper surface has a few groups of crowded stems which bear a few linear leaves. A broken specimen shows the interior to consist of a very pithy tissue, with a few roots traversing it from the clusters of stems above to the point of exit below.

Portions of the corky layer were submitted to various experts who could not agree as to whether it was of fungus origin, or caused or made by the insects inhabiting it. It is, however, probably not of pathological origin.

The plant is evidently of the lily family, genus *Nolina*, possibly species *humilis*. It is commonly called by the Mexicans 'palma.'

The Segregation of Fresh-Water Fishes. Theo. Gill.

One of the most remarkable facts in paleontology is the abruptness of the appearance of many families of fishes and especially of the fresh-water families of the great group of ostariophysans. This group or superorder contains the orders of Plectospondyles and Nematognaths. It is only within a little more than a decade that the relations of their families have been recognized, the plectospondyle families having been previously widely dispersed, the cyprinids and three related families having been placed in one section, the charocinids and erythrinids next to the salmonids, and the electrical eel and gymnotids next to the eels. Now, all these forms as well as the nematognaths or catfishes have practically no paleontological history, the earliest known, *Bucklandium* of the Eocene, being evidently a true silurid in a restricted sense. There are no intermediate forms, no generalized types known. When and how did they originate?

Both the Plectospondyles and Nematognaths are more diversely represented in South America than elsewhere and it appears to be most probable that the ancestral forms were developed in what is now South America or in regions of the southern hemisphere lost in the waters of the Pacific, or Atlantic. The origin may have commenced as far back even as the Devonian period. It may be recalled that ceratodontids are so closely related to recent forms that for a long time they were combined in the same genus and that no remains of species have been found in beds between the Jurassic and Pliocene Tertiary. What is true of ceratodontids may be true of other fishes.

The salt-water catfishes must be regarded as estrays from the fresh-water types that have accommodated themselves to new conditions.

The Exhibit of Living Animals at the St. Louis Exposition. A. B. Baker.

More effort was made to exhibit living animals at the St. Louis Exposition than at previous expositions. The National Zoological Park of Washington made a particularly good display of birds in a large cage divided into two compartments, one for land birds and the smaller water birds, and the other for the large water birds.

The exhibit was largely an experiment, as it was not known whether so many birds could be displayed on so large a scale. It was a success, however, the mortality, even among

the small birds, being very low. The public interest was very great.

The fish exhibit was large. Some difficulty was experienced at first in using water that had been chemically treated to render it clear. Harm to the exhibit was avoided by adopting a closed water supply.

The 390th regular meeting of the society was held on Saturday evening, November 5, 1904. Dr. C. W. Stiles spoke briefly of the meeting of the International Committee on Zoological Nomenclature which was held in Berne during the past summer. He stated that the International Code of Nomenclature had been revised only editorially. It is now in press in France and will appear soon in English, French and German.

General T. E. Wilcox, U.S.A., presented an illustrated lecture on 'The Flora of the Western United States and Alaska.' He discussed particularly the plants of parts of the Rio Grande Valley and southeastern Arizona. Incidents of a long period of observation were related and the peculiarities of various desert plants mentioned. Especial reference was made to the effects of aridity, irregularity of rainfall and rapid evaporation. Medicinal and otherwise useful plants were particularly mentioned. Notes on certain plants of Alaska, a more humid region, were also given.

WILFRED H. OSGOOD,
Secretary.

THE CHEMICAL SOCIETY OF WASHINGTON.

THE 152d regular meeting was held October 13, 1904, at the Cosmos Club. The program for the evening was as follows:

The Action of Ammonium Chloride on Sulphur Tetrachloride. P. FIREMAN.

A Comparison of the Wet and Crucible Fire Methods for the Assay of Gold Tellurides, with Notes on the Errors Incidental to the Operation of the Fire Assay and Parting. W. F. HILLEBRAND and E. T. ALLEN.

The authors showed that the fire assay for telluride gold ores, with proper precautions, is accurate. Other errors in fire assays, especially the volatility of gold during cupellation and the loss of gold in parting, were investigated. In regard to the former the error was shown to be much larger than has been formerly supposed. The solubility of gold in nitric and nitrous acid which has been claimed by some authors was shown to be entirely negligible.

An Examination of Lard from Cotton Seed Meal Fed Hogs by the Phytosterin Acetate Method of Bömer. L. M. TOLMAN.

The author examined fifteen samples of lard prepared from hogs which had been fed on cotton seed meal. All of the samples gave positive tests with the Halpen reagent but in none of them could phytosterol be found. This confirmed the work of Solstein. It was found, however, that small amounts of added cotton seed oil could be detected by this method. Also that cotton seed oil that had been heated to destroy the Halpen reaction could be detected.

L. S. MUNSON,
Secretary, pro tem.

THE 153d meeting was held November 10, 1904, at 8 o'clock in the assembly hall of the Cosmos Club. The president, Dr. E. T. Allen, called the meeting to order. After the election of Messrs. H. N. Stokes and S. S. Vorhees as councilors for the ensuing year, the following program was presented:

The first paper, entitled 'Calcium Sulphate in Aqueous Ammonium Sulphate Solution,' was presented by Dr. E. C. Sullivan. The results of the experiments showed that as the concentration of the ammonium sulphate increases the solubility of the calcium sulphate at first diminishes, and then increases. The general appearance of the curve corresponds to that of the solubility of calcium sulphate in sodium sulphate solutions, reported by Cameron at a previous meeting of this society. Conductivity determinations of the solutions seem to show that the concentration of the non-dissociated calcium sulphate does not remain constant.

Under the title of 'A Statistical Analysis of the Chemical Industries of the United States,' Professor Charles E. Munroe reviewed the history of the census of manufactures in the United States, describing briefly the methods for securing and classifying the returns and pointed out that while the sta-

tistics published for the entire manufacturing industries of the country taken as a whole are accurate to a high degree, the statistics for any single industry forming a part of this whole may, owing to the fact that to prevent duplication an establishment manufacturing a variety of products is classified according to that one of its products having the maximum value, be less accurate. He believes that this inaccuracy in presentation may be greatly remedied by a further analysis and segregation of the published data and that this analysis may be so extended as to show the disposition made of the products. This last process appears not to have been heretofore attempted, yet the results should prove to be not only of general interest but of special value in legislation and litigation where the rule of 'principal use' obtains and in manufacturing and other policies where the question of substitution may arise, while in the census work itself this data would furnish additional checks on the returns and the results. Examples of the results of such analyses as pertained to the wood distillation and the sulphuric acid industries were presented.

The last paper of the program, entitled 'Memories of Bunsen and Heidelberg,' was presented by Dr. W. F. Hillebrand. The speaker gave a description of the Heidelberg chemical laboratory as it was conducted by Bunsen thirty years ago. Personal reminiscences and experiences were recalled.

A. Seidell,
Secretary.

NEW YORK ACADEMY OF SCIENCES. SECTION OF BIOLOGY.

At the November meeting Professor Underwood presided. Dr. W. M. Wheeler, of the American Museum of Natural History, was elected chairman, and M. A. Bigelow, of Teachers College, Columbia University, secretary, of the section for the year 1905. Papers were presented by W. E. Kellicott, M. A. Bigelow and F. E. Lloyd.

Dr. Kellicott's paper, on the 'Development of the Venous System of *Ceratodus*,' pointed out many similarities to the amphibian. These similarities are so numerous and exact that it seems impossible to believe that the Dipnoi and Amphibia have not arisen as a common stock which has separated later into these groups. The adult relations and the mode of development of the vena cava of *Ceratodus* indicate that this vessel is not to be looked upon as one of the hepatic veins which has made a new connection with the posterior cardinal vein, but that its anterior portion develops as a short cut by way of which the blood from the mesonephros may be carried to the heart after the atrophy of the pronephros and the associated veins.

Mr. Bigelow briefly described some observations on eggs of the crustacean *Hippolyte* subjected to slight pressure during cleavage. While the normal cleavage is total, pressure prohibited the formation of cell-boundaries, and unsegmented eggs with 2, 4, 8, 16 and 32 nuclei were obtained. When the pressure was removed the cell-boundaries soon appeared. The cleavage of this egg under pressure exhibits some striking resemblances to the normal superficial cleavage of eggs of allies.

Professor Lloyd described the conditions for botanical research at the Desert Botanical Laboratory in Arizona. Many photographs were exhibited to illustrate descriptions of the peculiar flora in the vicinity of the laboratory and of the method of conducting experiments, especially those concerned with the relation of desert plants to water.

M. A. Bigelow,
Secretary.

CLEMSON COLLEGE SCIENCE CLUB.

The forty-ninth regular meeting of the Clemson College Science Club was held in the lecture room of the electrical laboratory, October 28, at 8:30 P.M. Dr. J. H. James gave a brief report of the summer meeting of the American Chemical Society, reviewing informally the more important papers. Professor W. M. Riggs gave an account of a new food product, practically a popped rice, prepared by a process invented by Dr. A. P. Anderson, a former member of the Clemson College faculty; and now being exhibited at St. Louis. The principal paper of the evening was by

Dr. F. H. H. Calhoun, who discussed two features of glaciation in the northwestern part of Montana. The first was as to the relative ages of the ice of the Kewatin ice sheet, and the ice of the mountain glaciers. The second dealt with the question of the Albertan drift period. From data gathered in the three river valleys, the conclusion was reached that the mountain ice was the older of the two sheets. In the valley of Birch Creek a valley train from the mountain glacier was found beneath lake deposit formed in front of the Kewatin ice sheet. In the valley of the Two Medicine River, the moraine of the mountain ice was covered by lake deposit, and in the same valley further east, the moraine of the Kewatin ice sheet rested on a valley train from the mountain glacier. In the valley of the Belly River, the mountain drift was found under the Kewatin drift. Dr. Calhoun also arrived at the conclusion that the so-called Albertan drift sheet of Dawson was nothing more than old river gravels picked up by the Kansan ice sheet, and now found at the bottom of that drift sheet. This paper will be published by the U. S. Geological Survey.

HAVEN METCALF,
Secretary.

ONONDAGA ACADEMY OF SCIENCE.

AT the last meeting of the Academy, held in Syracuse, N. Y., October 21, Dr. H. C. Cooper addressed the meeting on 'Physical Chemistry and its Service to the Other Sciences.'

Physical chemistry was shown to have an important bearing on physiology in virtue of the application of the modern theory of solution to vital processes and the discovery of the similarity of behavior between enzymes and inorganic contact agents. The work of van't Hoff and his pupils on chemical equilibria in various geological formations, and the determinations of the transition-points of geologically important substances were commended to the study of geologists. The speaker also showed how, by physico-chemical methods, various physiologically and mineralogically important substances have been prepared in the laboratory.

J. E. KIRKWOOD,
Corresponding Secretary.

WELLESLEY COLLEGE SCIENCE CLUB.

THE first regular meeting of the club for the year was held at the Whitin Observatory on October 18. Professor Ellen Hayes presented a paper on 'Nature the Master of Man.'

The second meeting was held in the Physics Lecture Room on November 8. Mr. Albert E. Leach, of the Massachusetts State Board of Health, read a paper on 'The Purity of our Food.'

GRACE E. DAVIS,
Secretary.

DISCUSSION AND CORRESPONDENCE.

DAVENPORT'S 'STATISTICAL METHODS.'

TO THE EDITOR OF SCIENCE: In the preface to the second edition of Dr. C. B. Davenport's useful 'Statistical Methods' occur the following sentences: "Especial attention is called to Table IV., which is an extension of Table IV. of the first edition that was calculated by Professor Frederick H. Safford, and appears to have been the first published table of the normal probability integrals based on the standard deviation. More recently Mr. W. F. Sheppard has published in *Biometrika* a similar table. * * *"

In justice to Mr. Sheppard I wish to point out that his tables in *Biometrika* are only the extension of the table which appears in his memoir read before the Royal Society in 1897 and issued in 1898 (cited by Dr. Davenport, second edition, pp. 84, 101). Dr. Davenport's first edition of his 'Statistical Methods' did not appear until 1899. Thus there can be no claim as to priority for Professor Safford's table of 1899. If we desire to be absolutely accurate in the matter, we shall probably not attribute the first published table even to Mr. Sheppard, still less to Professor Safford. On the other hand, Mr. Sheppard's table at present stands quite unsurpassed for its range, accuracy and the number of decimal places in the probability integral.

KARL PEARSON.

UNIVERSITY COLLEGE, LONDON, ENGLAND,
November 5, 1904.

CORALS.

TO THE EDITOR OF SCIENCE: I find myself in the position of an author replying to a

reviewer (pp. 503–5, October 14, 1904) with the greater part of whose remarks he is in cordial agreement, and whose work he has ever found to be characterized by the greatest care and the fullest consideration of every point.

My endeavor has been throughout to clearly show the species and to some small degree their variation, *vegetative, continuous* and *discontinuous*. My reason for not publishing *in detail* my observations on the influence of environment on mode of growth of corals was simply lack of means to pay for the necessary illustrations. I kept careful records of a considerable number of species for this purpose, but on reconsideration *now* I am of opinion that any account, or at least the first account, of the same should be written while still on the reef and capable of verifying any point that may arise. The best way would be to take the necessary physical observations in three or four different environments containing the same species of corals, to carefully chart the character and organisms of the same, and to show photographically their variations. The specimens, from six or eight square yards of each, being subsequently mounted in the positions in which they grew in respect to one another and other organisms, would form most instructive and unique exhibits in any museum which had the funds and enterprise to undertake such a work. The best locality would undoubtedly be the West Indies, since its broader physical conditions are, perhaps, better known than those of any other suitable coral-reef region, and because it is the home round which coral literature is entwined.

I used the term *continuous* in respect to variation in its ordinary sense, excluding, however, *vegetative* variation, that due to the action of the environment on the organism during its growth. I do not restrict the term to series from one locality grading into those from others, as it may be equally well seen in series from one locality, or even from one environment of the same. Where the *modes* of series from diverse localities differ in certain characters from one another, as seems to me frequently to be the case, and yet the individual specimens of the different species merge, we would seem to have before us *true* cases of natural selection acting on *continuous* variation. Yet—and this is the point—*neither new species nor new genera seem to result from this action.*

In attempting to adopt a classification more in accordance with our present ideas than that of Duncan, I found that I had in the works cited by Mr. Wayland Vaughan less than a quarter of the information required to turn out a 'good job,' and less than a sixth of the necessary specimens in Cambridge required to complete the other three quarters. Under the circumstances I treated each genus by itself, satisfying myself first as to its validity, merely adopting a well-known order for convenience of reference. I tried to lay the foundations in the species themselves, and I left the gross classification in the hope that some one, who has the specimens—I know no one more capable and with wider knowledge of recent and fossil corals than your reviewer—might be induced to consider the whole. Further, in the present state of our knowledge I found it hopeless to work out a *scientific* classification, based, as I consider such must be, on the polyphyletic origins of the so-called astræid, fungid and perforate groups.

I have no doubt Mr. Wayland Vaughan is correct in respect to the generic names to which he refers. I have, however, considered the identity of *Mussa* with *Symphyllia* and of *Cœloria* with *Mæcendrina,* and in spite of Professor Verrill's and Mr. Wayland Vaughan's opinions I still separate them; the anatomy and development of their polyps and coralla should be compared and would settle the question.

J. Stanley Gardiner.
Cambridge, England.

Some Further Comments on the Guatemalan Boll Weevil Ant.

In his reply to my remarks on the feasibility of establishing the Guatemalan boll weevil ant in Texas, Dr. O. F. Cook shows how dubious are the claims for the much-advertised efficiency of this insect. Clearly there are two distinct problems involved in the discussion; first, the establishment of the boll weevil ant in the southern states, and

second, its efficiency as a boll weevil destroyer. My paper dealt largely with the former, since it is, of course, the *conditio sine qua non* of the latter problem. Dr. Cook calls my remarks a '*post facto* prognosis,' wishing, I suppose, to create the impression by this *contradictio in terminis,* that his *Schmerzenskind,* the kelep, to which the Department of Agriculture has been standing sponsor, is doing remarkably well. I will pass over the fact that this implication is hardly borne out by the latest reports from the field of experimentation, and consider some of Dr. Cook's statements.

He says that 'it was obvious to Professor Wheeler from the first that the case was hopeless.' This statement is false, inasmuch as neither I nor anybody else outside of the Department of Agriculture could have had *any* opinion on this subject till very recently, for the very simple reason that the scientific name of the ant was not made public by the Department till its great value as a boll weevil destroyer had been boomed in all the newspapers of the country. The kelep, as Dr. Cook informs us, was discovered 'on the cotton April 20, 1904, in Alta Vera Paz, Guatemala, and its efficiency as a destroyer of the Mexican cotton boll weevil was demonstrated the following day.' But even in his official report, which could hardly have been published before August 1, the scientific name of the ant was not given and it was several weeks later before I could ascertain it.

Dr. Cook further says that I have disregarded 'several facts which might have mitigated the confidence of the prophesy.' The first of these is a straw fact of Dr. Cook's own manufacture, namely the supposition that I am of the opinion that *Ectatomma* is very much like *Odontomachus.** I am at a loss to know how I could have given this impression, as the only time I associated these genera directly was when I considered *Odontomachus* to be more dominant, more variable and more widely distributed than other Ponerinæ, *Ectatomma,* of course, included. This statement has not even been met, to say nothing of having been refuted, by Dr. Cook.*

It is, in fact, Dr. Cook himself who should be glad to have the kelep more like *Odontomachus.* At any rate, he makes a futile attempt to show that the kelep is a dominant, 'enterprising' ant, with large colonies (*i. e.,* prolific) and highly adaptable. But closer examination shows that the kelep is like the other Ponerinæ in being below par in all of these respects. It is 'dominant' only in the cotton fields of Guatemala, and very rare or absent elsewhere in that country. It is 'enterprising' although 'compared with the nervous haste of many other species, its motions

* Dr. Cook is 'ready to follow Mayr and Ashmead in assigning these genera to separate families.' In other words, the genus *Odontomachus* should be separated from the Ponerinæ (or Poneridæ as Cook and Ashmead persist in calling the group) and made the type of a distinct family, the Odontomachidæ. This was Mayr's opinion many years ago, but it is probable that he now believes with the eminent myrmecologists Emery and Forel that *Odontomachus* (together with *Anochetus* and *Champsomyrmex*) can not be separated as a distinct family, but has hardly more than tribal value. The only characters on which such a separation could be effected are the peculiar shape of the petiole and mandibles. But the very same kind of a petiole is found in certain undoubted Ponerinæ, like the South American *Leptogenys unistimulosa,* and if the shape of the jaws is such an important character, we should have to make several families out of such genera as the myrmicine *Strumigenys,* some species of which, like *S. louisianæ, grandidieri,* etc., have mandibles very much like *Odontomachus.* But this would be absurd, hence it is best to let well enough alone. Moreover, the shape of the mandibles in different genera of the Ponerinæ (*e. g.,* in *Harpegnathus, Thaumatomyrmex, Mystrium,* etc.) is so diverse that this subfamily would have to be resolved into a great number of families, if we were to follow Cook's example with *Odontomachus.* Undoubtedly this would give a fine opportunity for a display of the *mihi* itch, but the cause of science would be little furthered thereby.

* The larva of *Ectatomma* is much more primitive in its characters than that of many other Ponerinæ, whereas the larva of *Odontomachus* is much like that of the typical genus *Ponera.* This fact, too, has an important bearing on the taxonomic position of *Odontomachus* discussed in the preceding foot-note.

are slow and deliberate (sic!), and, like the so-called praying mantis, it stands for long periods quite motionless, with the antennæ and mandibles extended, ready for something to come that way and be caught.' This must be 'enterprise' as understood by the Jewish tailor of the comic papers who stands in the doorway of his shop waiting for customers.

It seems that I was mistaken in supposing that the colonies of the kelep contain only from 20 to 110 workers, though these numbers were taken from Dr. Cook's own statement concerning the colonies introduced into Texas. We are now told that they (not the colonies in Texas!) comprise between 200 and 300 individuals and that 'there are seldom less than 100 and sometimes 400 or more.' Now even if we put the number at 500, these are still very small colonies, as ant colonies go, and show conclusively that the kelep, like other Ponerinæ, must be either short-lived or much less prolific than other ants, or both.

The adaptability of the kelep, according to Dr. Cook, is 'shown by its association with the cotton for the sake of its nectar, as well as by its skill in stinging the boll weevil.' If this shows anything it does not show adaptability but adaptation, which is a very different matter. The first part of Dr. Cook's statement, together with several of his previous statements, implies that the cotton plant and the kelep live in a state of symbiosis, like that which has been claimed to exist between the South American *Cecropia* tree and the ant *Azteca instabilis*, and between the African and tropical American acacias and the species of *Sima* and *Pseudomyrma* respectively. These classical cases, however, have never been demonstrated to the satisfaction of either the botanists or the myrmecologists. Any one who observes without bias the insects visiting many plants with extra-floral nectaries, like our species of *Cassia, Ricinus, Stillingia, Populus*, etc., will find that certainly in such cases no symbiosis exists. Not only do all sorts of ants, mutillids, bees, wasps, beetles, flies, etc., visit the extra-floral nectaries, but caterpillars, chrysomelid larvæ, etc., may be found feeding with impunity on the lacerated foliage of the plants thus 'protected.' It is possible, of course, that some of the cases of so-called ant and plant symbiosis may be genuine, but before any such statement can be made of a particular case like the cotton plant, we need much more concise, abundant and painstaking observations than have been published hitherto.

I fail to see, therefore, that Dr. Cook has produced any facts that could lead me to 'mitigate' the statements made in my former paper. The kelep is a typical ponerine ant, with all the disadvantages of a fixed and archaic constitution in the presence of experiments that require for their successful execution a plastic and adaptable species. When the kelep has succeeded in becoming a thriving component of the Texan ant fauna there will be time enough to determine whether its strenuous and enterprising efforts can 'add even ten per cent. to the cotton crop'—we will not expect it to chase all the boll weevils into the Gulf of Mexico. Dr. Cook himself admits that 'the chances are still very much against it, no doubt.' This is exactly what I have maintained. Neither I nor any one else blames the Department of Agriculture for following every clue till some 'concrete conclusion' is reached, but the premature and persistent booming of a conclusion which is far from being 'concrete' and has 'chances very much against it' can only discredit the Department of Agriculture, Dr. Cook and the unsuspecting kelep in the eyes of the general public, the Texan cotton grower and the scientist. I shall have no further remarks to make on the kelep and am satisfied to await patiently the concretion of the conclusions—even till the Greek calends.

William Morton Wheeler.

Are they sympathetic drums?

To the Editor of Science: Some of the African xylophones (marimbas) and those of Central America, which negro slaves introduced there, have resonators—gourds, or cylinders of cane or of bamboo, placed beneath each sounding-bar. Often at the lower end the side of each resonator is pierced with a lateral hole and covered with a thin film or membrane. I have never found a reasonable ex-

planation why this construction was so often made. I had ascribed it to savage fetish, but is there not a better reason for it? I suspect that the film acts as a sympathetic drum, like that of the nyasataranga of India, the onion flute of Europe, and its late reproductions in the kazoo and zobo. In that case, it increases the volume of sound and adds a different timbre to the marimba, as it does to the other instruments mentioned. The same reasons may also be ascribed for the use of the membrane over a lateral hole of the Chinese flute (ti-tzŭ) and other flutes of the far east.

E. H. HAWLEY.

U. S. NATIONAL MUSEUM,
November 15, 1904.

QUOTATIONS.

SCIENCE IN THE BRITISH WEST INDIES.

THE American Consul at Bermuda describes in a United States Consular Report the steps which have been taken to establish there a biological station which will be to North America what the Naples station is to Europe. For several years American naturalists have carried on investigations of the natural history of the Bermudas and the surrounding sea, and have made efforts to establish a biological station in these islands. Upon the advice of the Royal Society, our government has given its assent to the project. The Colonial Government has expressed its willingness to purchase the land and erect the building, and grants toward equipment and support of tables have been made by the Royal Society and the Carnegie Institution. Harvard University and New York University, in connection with the Bermuda Natural History Society, have already commenced work in a temporary laboratory close to what will be the permanent quarters of the station, and the United States Government has been asked to give generous support to the station. America has already founded a tropical botanical laboratory in buildings of the government of Jamaica at Cinchona, and has now secured a biological station, so that it appears as if the Americans are rapidly getting the control of the scientific interests of our western tropical possessions. While we can not but admire the interest shown in the establishment of these stations by universities and colleges in the United States, it is impossible not to regret the apathy with which our home and colonial governments regard such matters. Surely it is the duty of the state to encourage the pursuit and cultivation of natural knowledge throughout the Empire, and to realize the richness of its possessions in material for scientific study as well as in precious minerals. It is a reproach to our nation that a biological station has not been established by us in the Bermudas; for now, instead of American investigators carrying on their work in a British station, we have to face the fact that, though the station will be on British soil, it will belong to the United States, and our own countrymen will be guests in it. So far as the interests of science are concerned, probably this does not matter; for, as Mr. Balfour wrote a few days ago to the translator of his British Association address, community of aim 'binds together the scientific men throughout the world into one international brotherhood." But it should be evident to some of our ministers, at least to Mr. Balfour, who has often expressed sympathy with scientific progress, that it can not be to the advantage of the state for another nation to accept responsibilities which belong to us. Mr. Balfour is gratified at the success of the translation of his address into German, but apparently he does not consider that the interest shown in scientific matters in Germany is due to the active and practical part played by the state in helping scientific education and research. What we want here and in all parts of the Empire is more practical help of the kind given by the United States and Germany to save us from the future regret of lost opportunities.—*Nature.*

ECONOMIC ENTOMOLOGY AT THE WORLD'S FAIR.

THERE prevails in Europe a very proper idea that the United States takes the lead in economic entomology. It must, therefore, have been somewhat surprising to our foreign friends, upon visiting St. Louis, to have found our station collections of insects so poorly

represented. The government exhibit of insects, in the government building, of course, was excellent, and in the forestry building the exhibit of Dr. Felt, and Dr. Smith's collection of mosquitoes were admirable, but in the station exhibits in the Palace of Education there was a woeful lack of representative matter from the various stations. Professor Gillette tells me that he had for the exhibit contributions from California, Connecticut, Colorado, Hawaii, Kansas, Kentucky, Indiana, Idaho, Louisiana, Maine, Maryland, Minnesota, Missouri, Montana, Nebraska, New York (Geneva, Cornell), New Mexico, New Hampshire, New Jersey, Ohio, Oregon, Pennsylvania, Rhode Island, Texas and Virginia. In many instances these representative collections were extremely small. Professor Gillette is by no means to be blamed for this lack of representation, for he has, with the limited means at his command, certainly done all he could to forward this work and both he and Mr. Farmer have installed the material with great care and with resulting good effect. Nor does the writer believe it is due to apathy on the part of the station entomologists, but rather to the fact that the time of the entomologists is so crowded with other exacting work, that no time is left for preparation of any such exhibit as was called for in this connection, nor were funds available. Whatever may have been the cause, the result was an inadequate representation of the interest in economic entomology, and as such it is to be deplored.

In connection with Dr. Smith's exhibit of mosquitoes in the forestry building, which was certainly one of the most complete that has ever been placed before the public, illustrating not only a large number of species, but different phases in the work against the mosquito, we must remark on a colored illustration labeled 'Anopheles in the Act of Biting' or words to that effect. It represents an enlarged figure of a mosquito filled with blood, and with beak inserted, *but the beak and body are at right angles to each other.* While we may be mistaken, we are under the impression that this genus, in biting, always so raises the body that it and the beak are on the same line. In the education building, Professor Stedman had, in addition to his station exhibit of insects and photographs, a good show collection in Missouri's state educational exhibit, and Dr. Fernald had an interesting and instructive exhibit of insects (largely specimens of the gypsy moth and its enemies), insecticides and photographs in the Massachusetts educational exhibit, but the latter exhibit would never be found by an entomologist unless he were guided to it.

F. L. Washburn.
Minnesota State Experiment Station,
November 8, 1904.

MEDALS OF THE ROYAL SOCIETY.

The council of the Royal Society have made the following awards of medals for this year: The Copley medal to Sir William Crookes, F.R.S., for his long-continued researches in spectroscopic chemistry, on electrical and mechanical phenomena in highly rarefied gases, on radio-active phenomena, and other subjects. The Rumford medal to Professor Ernest Rutherford, F.R.S., for his researches on radio-activity, particularly for his discovery of the existence and properties of the gaseous emanations from radio-active bodies. A Royal medal to Professor William Burnside, F.R.S., for his researches in mathematics, particularly in the theory of groups. A Royal medal to Colonel David Bruce, R.A.M.C., F.R.S., for his researches in the pathology of Malta fever, nagana and sleeping sickness, and especially for his discoveries as regards the exact causes of these diseases. The Davy medal to Professor William Henry Perkin, jr., F.R.S., for his discoveries in organic chemistry. The Darwin medal to Mr. William Bateson, F.R.S., for his contributions to the theory of organic evolution by his researches on variation and heredity. The Sylvester medal to Professor Georg Cantor for his researches in the theories of aggregates and of sets of points of the arithmetic continuum, of transfinite numbers, and Fourier's series. The Hughes medal to Mr. Joseph Wilson Swan for his invention of the electric incandescent lamp and various improvements in the practical applications of electricity.

PHILADELPHIA MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE fifty-fourth annual meeting of the American Association for the Advancement of Science, and the third of the 'Convocation week' meetings, will be held in Philadelphia, Pa., December 27, 1904, to December 31, 1904, in the buildings of the University of Pennsylvania. Hotel headquarters have been established at the Hotel Walton, Broad and Locust Streets.

The officers of the local committee are: President, Provost Charles C. Harrison; vice-president, Professor Edgar F. Smith; secretary, Dr. Philip P. Calvert; treasurer, Dr. Samuel G. Dixon; chairman of the executive committee, Provost Charles C. Harrison; of the committee on reception and entertainment, Mrs. Charles C. Harrison; of the committee on hotels and boarding houses, Professor Amos P. Brown; of the committee on meeting places and equipment, Professor Edwin G. Conklin; of the committee on press and printing, Mr. George E. Nitzsche; of the committee on transportation, Mr. Walter Wood; of the committee on finance, Mr. S. F. Houston.

A railroad rate of one fare and one third for the round trip, on the certificate plan, has been granted by the Central Passenger Association, Southeastern Passenger Association, Trunk Line Association and New England Passenger Association. The same rate is expected, and will probably be granted by the Western and the Southwestern Associations. Certificates will also be issued from points in Canada east of and including Toronto. The Transcontinental Passenger Association have on sale daily from Pacific coast points, regular nine months' tourist tickets to Chicago, St. Louis, Memphis and New Orleans, at rates which approximate one fare and one third for the round trip.

The program for the entire meeting will be issued on Wednesday, December 28. Copies may be obtained at hotel headquarters and at the office of the permanent secretary, in Houston Hall. No 'Daily Program' will be issued as at former meetings. The following events may be announced in advance:

Tuesday, December 27, 1904, the regular meeting of the executive committee of the council, consisting of the general secretary, the secretary of the council and the secretaries of the different sections, will be held at noon in the rooms of the permanent secretary, at the Hotel Walton.

Wednesday, December 28, 1904, meeting of the council at 9 A.M. in the auditorium, Houston Hall. First general session of the association at 10 A.M. in the Chapel, College Hall. The meeting will be called to order by the retiring president, Dr. Carroll D. Wright, who will introduce the president-elect, Dr. W. G. Farlow. Addresses of welcome will be delivered by members of the local committee, to which President Farlow will reply. Announcements by the general, permanent and local secretaries. Adjournment of the general session, to be followed by the organization of the sections in their respective halls.

Addresses of the vice-presidents will be given as follows: At 2:30 P.M.—Vice-President Tittmann before the Section of Mathematics and Astronomy, in College Hall. Vice-President Bancroft before the Section of Chemistry, in Harrison Laboratory of Chemistry. Vice-President Russell before the Section of Geology and Geography, in Geological Laboratory, College Hall. Vice-President Mark before the Section of Zoology, in Laboratory of Physiology and Pathology.

The address by Dr. Carroll D. Wright, the retiring president of the association, will be given at 8 P.M.

Thursday, December 29, 1904, at 2:30 P.M.—Vice-President Hall before the Section of Physics, in Morgan Laboratory of Physics. Vice-President MacBride before the Section of Botany, in Biological Hall. Vice-President Baldwin before the Section of Social and Economic Science, in Logan Hall.

Friday, December 30, 1904, at 2:30 P.M.—Vice-President Woodward before the Section of Mechanical Science and Engineering, in Mechanical Engineering Building. Vice-President Saville before the Section of Anthropology, in the Museum of Science and Art.

All meetings will be held in the buildings

of the University of Pennsylvania. The rooms assigned to the various sections of the association and to the affiliated societies are indicated below:

General Meetings.—The opening session on Wednesday morning and the brief daily session at 10 A.M. will be held in the Chapel, College Hall.

Council Room.—The council will meet daily, at 9 A.M., in the auditorium of Houston Hall.

Permanent Secretary.—The office of the permanent secretary will be located on the first floor of Houston Hall. Here will be found post office, registration, and railroad certificate facilities.

Section A, Mathematics and Astronomy.—College Hall.

Section B, Physics.—Morgan Laboratory of Physics.

Section C, Chemistry.—Harrison Laboratory of Chemistry.

Section D, Mechanical Science and Engineering.—Mechanical Engineering Building.

Section E, Geology and Geography.—Geological Laboratory, College Hall.

Section F, Zoology.—Laboratory of Physiology and Pathology.

Section G, Botany.—Biological Hall.

Section H, Anthropology.—Museum of Science and Art.

Section I, Social and Economic Science.—Logan Hall.

Section K, Physiology and Experimental Medicine.—Laboratory of Physiology and Pathology.

American Anthropological Association.—Museum of Science and Art.

American Chemical Society.—Harrison Laboratory of Chemistry.

American Folk-Lore Society.—Museum of Science and Art.

American Philosophical Association.—Logan Hall.

American Physical Society.—Morgan Laboratory of Physics.

American Physiological Society.—Laboratory of Physiology and Pathology.

American Psychological Association.—Psychological Laboratory, College Hall.

American Society of Naturalists.—Laboratory of Physiology and Pathology.

American Society of Zoologists (Eastern Branch).—Laboratory of Physiology and Pathology.

Association of American Anatomists.—Wistar Institute of Anatomy.

Association of Economic Entomologists.—Laboratory of Physiology and Pathology.

Astronomical and Astrophysical Society of America.—College Hall.

Botanical Club of the A. A. A. S.—Biological Hall.

Botanical Society of America.—Biological Hall.

Entomological Club of the A. A. A. S.—Laboratory of Physiology and Pathology.

Fern Chapter.—Biological Hall.

Geological Society of America.—Geological Laboratory, College Hall.

Society of American Bacteriologists.—Laboratory of Hygiene.

Society for Horticultural Science.—Biological Hall.

Society for Plant Morphology and Physiology.—Biological Hall.

Society for Promotion of Agricultural Science.—Logan Hall.

Society of the Sigma Xi.—Houston Hall, Auditorium.

Sullivant Moss Chapter.—Biological Hall.

Wild Flower Preservation Society of America.—Biological Hall.

SCIENTIFIC NOTES AND NEWS.

On the occasion of the birthday of King Edward honors were conferred upon men of science as follows: Mr. W. H. M. Christie, C.B., F.R.S., has been promoted to the rank of Knight Commander of the Order of the Bath (K.C.B. Civil Division). Dr. J. W. Swan, F.R.S., has received the honor of knighthood. The Hon. C. A. Parsons, F.R.S., has been appointed a companion of the order of the Bath (C.B.).

Oxford University will confer the degree of D.Sc. on Dr. Harald Höffding of the University of Copenhagen.

The seventieth birthday of Professor G. H. Quincke, professor of physics at Heidelberg,

was celebrated on November 19. Professor Kohlrausch, of Berlin, was the president of a committee that presented him with an album containing the autograph photographs of leading physicists.

THE Vienna Academy of Sciences has re-elected Professor Eduard Suess as president.

CORRESPONDING members of the Academy of Sciences at Göttingen have been elected as follows: Professors Gustav Retzius, of Stockholm; Ernst Wilhelm Benecke, of Strasburg; Paul Ehrlich, of Frankfort, and Ewald Hering, of Leipzig.

PROFESSOR HENRY S. GRAVES, director of the Yale School of Forestry, has been commissioned by the Bureau of Forestry to undertake inspection work in the Philippines. He will also undertake commissions in India for the Forestry Bureau in the Philippines. He will leave New York on December 3, and return early in May. During the winter Professor Graves's courses will be conducted by Dr. Bernhard E. Fernow, formerly director of the Cornell School of Forestry.

FOREIGN journals state that Dr. Francisco de los Cobos, a physician of Buenos Aires, is in Spain as representative of the scientific societies of Argentina, seeking the support of the Spanish Government for the creation of a Hispano-American University.

DR. CATTO has been awarded the Craggs prize of the London School of Tropical Medicine for his discovery of a new schistosomum parasite of man.

THE Middleton Goldsmith lecture of the New York Pathological Society was delivered at the New York Academy of Medicine, on November 30, at 8:30 o'clock, by Dr. Charles Wardell Stiles, chief of the Division of Zoology, Hygienic Laboratory, U. S. Public Health and Marine-Hospital Service. The subject was: 'Zoological Pitfalls for the Pathologist.'

THE first ordinary meeting of the Royal Statistical Society for the present session was held at the Society of Arts, on November 15, when Sir Francis Sharp Powell, Bart., M.P., delivered an inaugural address.

DR. HENRY S. CONARD, for four years Harrison fellow and now instructor in botany in the University of Pennsylvania, is about completing his monograph of the water-lilies (*Nymphæa*), which has occupied a large part of his time since 1899. The book will be published by the Carnegie Institution of Washington. It is expected to appear in December of this year, or early in January.

THE Walsingham medal, of Cambridge University, for 1903, not having been adjudged, the Special Board for Biology and Geology has agreed to recommend its award as an additional medal for the present year, and the medal has accordingly been adjudged to Mr. R. P. Gregory, B.A., fellow of St. John's, and Mr. Keith Lucas, B.A., fellow of Trinity. Mr. Gregory's essay was entitled 'The Reduction of Division in Plants and its Significance in the Physiology of Heredity.' Mr. Lucas's essay was entitled 'The Augmentor and Depressor Effects of Tension on the Activity of Skeletal Muscle.'

MR. W. H. PICKERING, late chief of the inspecting staff of the Yorkshire and Leeds Mining Districts, has been appointed chief inspector of mines in India.

A CHAPTER of the Scientific Society of the Sigma Xi has been organized at the Case School of Applied Science, with Professor J. W. Langley as president.

THE 'Harben Lectures' of the Royal Institute of Public Health, will be given in King's College, London, on Friday, November 25, December 2 and 9, by Professor John McFadyean, M.B., B.Sc., principal of the Royal Veterinary College, London, on 'Glanders.'

PROFESSOR MARSHALL WARD, F.R.S., has been elected president, and Professor Thomson, F.R.S., Professor Liveing, F.R.S., and Dr. Hobson, F.R.S., vice-presidents of the Cambridge Philosophical Society.

HENRY MCCALLEY, of the Geological Survey of Alabama died at Huntsville, Alabama, of pneumonia on the November 20, 1904, in the fifty-third year of his age. Mr. McCalley was graduated from the University of Virginia with the degrees B.S., C.E. and M.E. in 1875. From 1878 to 1885 he was assistant in

the Department of Chemistry at the University of Alabama and a volunteer on the staff of the Geological Survey. From 1883 to the time of his death he was chief assistant on the Geological Survey, in which capacity he traveled over the greater part of the state, and prepared reports dealing mainly with the coal and iron. He was secretary and treasurer of the Alabama Industrial and Scientific Society; member of the American Association for the Advancement of Science; member of the American Institute of Mining Engineers, and fellow of the Geological Society of America.

THE deaths are announced of Forstmeister Schering, formerly professor of mathematics and geodesy in the School of Forestry at Munich; and of Dr. Francesco Chizzoni, professor of geometry at Modena.

WE regret also to record the death of Dr. Karl Senhofer professor of chemistry at the University of Innsbrück; of M. J. Macé de Lépinay, professor of physics, and of M. Pauchon, professor of agricultural botany, both of Marseilles.

MR. OTTO YOUNG has donated $100,000 to the endowment or building fund of the McCormick Memorial Institute for Infectious Diseases, Chicago.

Nature states that Mr. James Cosmo Melvill has presented his general herbarium to the Manchester Museum of the Victoria University. The herbarium has taken nearly forty years to collect, and it was formally opened in its new quarters by Sir W. T. Thistelton-Dyer, K.C.M.G., on October 31.

THE teachers of mathematics in the Middle States and Maryland met at Princeton on November 28. Professor Gustave Legras of the College of the City of New York, who is chairman of the New York section of the Association, read a paper on 'Present Tendencies in the Teaching of Mathematics in Other Countries.'

THE annual meeting of the Association of Mathematical Teachers in New England was held at Harvard University. William A. Francis of Exeter, N. H., was elected president, Professor Nathaniel F. Davis of Brown University vice president and Mr. George W. Evans of the English High School, Boston, secretary.

WE learn from *Nature* that the inaugural meeting of the Association of Economic Biologists was held at Burlington House on Tuesday, November 8. Mr. F. V. Theobald occupied the chair, and in the course of his introductory remarks he detailed the steps taken by Mr. Walter E. Collinge to found the association. He hoped that the association would welcome all investigators in economic biology, whether agricultural, medical or commercial. The relationship between biology and agriculture was apparent to all, but only recently had the importance of its relationships with medicine and commerce been realized. Membership of the association will be confined to workers in economic biology. The following officers have been elected for 1904–5: *president,* Mr. Fred V. Theobald; *vice-president,* Mr. A. F. Shipley, F.R.S.; *council,* Professor G. S. Boulger, Professor A. H. R. Buller, Professor Geo. H. Carpenter, Dr. Francis Marshall, Mr. Robert Newstead, Major Ronald Ross, F.R.S., Mr. Fraser Storey, Mr. Cecil Warburton; *hon. treasurer,* Mr. Herbert Stone; *hon. secretary,* Mr. Walter E. Collinge. The next meeting will be held at Birmingham in April, 1905:

THE forthcoming second edition of the German version of Mr. Balfour's presidential address to the British Association has brought, as we learn from the London *Times,* to the translator, Dr. M. Ernst, London correspondent of the *Neues Wiener Tagblatt,* the following letter from the Prime Minister:

10, Downing-street, Whitehall, S. W.,
Nov. 10, 1904.

My dear Sir:—I am much gratified to learn that there has been a sufficient demand for the German translation of my address to the British Association to make it worth while to issue a second edition; and all the more because the address touches on a middle region between physical science and philosophy, in which, as a rule, neither men of science nor philosophers are greatly interested.

At Cambridge, where the address was delivered, I had the honour of meeting some most distinguished German men of science, who took an im-

portant part in the various discussions with which the British Association busied itself. I would that the disinterested community of aim which thus binds together the scientific men throughout the world into one international brotherhood could extend its healing influence through all classes and all interests.

I remain yours faithfully,
ARTHUR JAMES BALFOUR.

THE Liverpool School of Tropical Medicine has, says the London *Times*, issued a series of reports on trypanosomiasis, that is to say, on the presence in the blood of man, and in the fluids of the brain and spinal cord, of some form of the microscopic parasite known as 'Trypanosoma,' which, having long been recognized as the cause of the virulent equine disease which is propagated by the tsetse fly in South Africa, has lately been discovered to be also the cause of 'sleeping sickness' in the human subject. The reports of Drs. Dutton, Todd and Christy have been sent home in instalments, some of which have already appeared in the medical journals. These and others are collected together in the present volume, which also contains an important note on the tsetse flies, by Mr. E. E. Austen, of the Zoological Department of the British Museum, and illustrations of flies and larvæ from the Congo. The details of cases given in the reports are, in a general way, too full of medical technicalities to be of general interest; but they seem to establish conclusively that 'sleeping sickness' is trypanosomiasis, although there are severe and even fatal cases of the latter in which the somnolence is not observed. The symptoms and the danger appear to bear some relation to the greater or less abundance of the parasites, and to become more marked and more serious when these have gained access to the cerebro-spinal fluid. The parasites may be present in the blood of deeply-seated organs when they are not discoverable in that which is drawn from a surface puncture; and their frequent temporary disappearances from surface blood render it sometimes difficult to be certain of their presence in the system. At the same time it appears that the term sleeping sickness is used very loosely among the Congo natives; and in many of the persons said to be suffering from it, and therefore brought to the hospital, the diagnosis was not confirmed either by the detection of the parasites or by the further progress of the case. One of the most curious results of the expedition has been the discovery of a bloodsucking larva of nocturnal habits, which seems to be abundant in many parts of the Congo, and which, during the daytime, seeks concealment in the cracks of the native floors, from which it may be dug out full of bright red blood as an evidence of the nature and the abundance of its previous night's meal. It is the larva of the *Glossina* fly, which appears to be harmless in the *imago* state, although it is probable that for this harmlessness the larva makes abundant compensation. The discovery will probably lead to the adoption of systematic measures for its destruction.

A REVIEW of the laws forbidding the pollution of inland waters in the United States has been prepared by Mr. Edwin B. Goddell for the United States Geological Survey. It is published as No. 103 of the series of Water-Supply and Irrigation papers. Mr. Goodell's purpose has not been to prepare a complete work on water pollution for the use of members of the bench and bar, but rather to put into the hands of public officials, legislators, water companies, manufacturers, farmers and others interested in the subject, a guide for their action, and to furnish references to the sources from which a more exhaustive knowledge of the subject may be obtained if required. No attempt has been made to present a detailed statement of the entire law against water pollution as it exists independently of statutes, but the broad legal principles under which antipollution statutes become operative are explained and important court decisions are quoted to show authority for various deductions. These principles and decisions have been classified and are presented in three groups: (1) The rights of riparian owners to pure water as against one another. (2) The rights of the public (as distinguished from individual owners) to have inland waters kept free from pollution by riparian owners or others. (3) The conditions under which, and the extent to which, public municipalities

may use inland waters in the disposal of sewage matter from public sewers. The statutes enacted in various states are classified according to their general scope and an opportunity is thus afforded to compare their effectiveness and desirability. In some states there is nothing more than a simple provision making it a crime to poison wells and springs, while in others elaborate provisions have been made to check and, so far as possible, absolutely prevent all pollution of all waters by the refuse products of animal life or the waste of human industry. In citing the statutes, Mr. Goodell has grouped the states together logically to show the stage of growth in sanitary education at which each has arrived. It is hoped that the publication and distribution of this paper will help to bring about a general apprehension of correct principles upon the important subject of water pollution.

UNIVERSITY AND EDUCATIONAL NEWS.

The John Bell Scott Memorial Laboratory of Physical Science, at Wesleyan University, Middletown, Conn., will be dedicated on December 7. The address will be delivered by Dr. Edward B. Rosa, on 'The National Bureau of Standards and its Relations to Scientific and Technical Laboratories.'

We learn from the London *Times* that at the beginning of last year an appeal was made by Dublin University for a fund for the development and better equipment of the science schools in Trinity College. Lord Iveagh offered to provide all the estimated building expenses (a sum of £34,000) conditionally upon the amount required for annual expenses being obtained by public subscription. For the latter purpose a capital of £78,000 is required. The committee in charge of the fund announce to-day that of this amount £15,886 has now been subscribed or promised, a site and designs have already been prepared for a new physical laboratory, and building operations will begin before the end of the year.

New medical buildings and the George Holt Physics Laboratory, which have been added to the Liverpool University, were opened on November 12. The inauguration proceedings took place in St. George's-hall and were presided over by the Chancellor of the University, Lord Derby, who was accompanied by Lord Kelvin, Mr. Haldane, K.C., M.P., Lord Cross and representatives of the English universities. The buildings have been erected at a cost of £21,600, which has been subscribed by Liverpool merchants and representatives of local families.

The following promotions and appointments have been made in the Department of Mathematics and Astronomy of the University of Pennsylvania: George H. Hallett, Ph.D., has been promoted to an assistant professorship of mathematics; Eric Doolittle, C.E., to an assistant professorship of astronomy; Henry B. Evans, M.E., Ph.D., has been appointed assistant professor of mathematics.

Dr. Albert Woelfel has resigned his position in the Memorial Institute for Infectious diseases, Chicago, to accept an appointment in the Department of Physiology, of University of Chicago.

We learn from *The Electrical World* that Professor Harry E. Clifford, acting head of the department of electrical engineering in the Massachusetts Institute of Technology, has been appointed to the free professorship of theoretical electricity in the institute. Mr. W. S. Barstow has been elected a member of the faculty of the Polytechnic Institute of Brooklyn. Mr. Barstow will serve in the department of electrical engineering as consulting professor of central station practice. Mr. Charles F. Scott has become a member of the board of consulting professors of the department of electrical engineering of the institute.

Mr. R. P. Gregory, demonstrator of botany, and Mr. E. Cunningham, senior wrangler, 1902, have been elected fellows of St. John's College, Cambridge.

Professor Svante Arrhenius, of Stockholm, has been called to the University of Berlin.

Dr. W. Nernst, of Göttingen, has been called to Charlottenburg, as director of the Reichsanstalt.

Dr. Otto Lummer, of the Reichanstalt, has been appointed professor of physics at the University of Breslau.